SCIENCE ABSTRACTS.

Section A.—PHYSICS.

APRIL, 1932.

GENERAL PHYSICS.

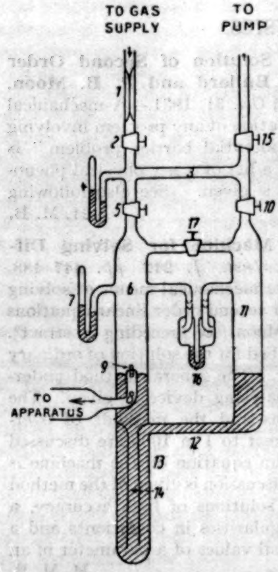
1057. Mechanical Method for the Solution of Second Order Linear Differential Equations. E. C. Bullard and P. B. Moon. *Cambridge Phil. Soc., Proc.* 27. *pp.* 546–552, *Oct.* 31, 1931.—A mechanical device is sketched which gives directly a solution of any problem involving a second order linear equation. The "potential barrier problem" is taken as an illustration of the method, and a list of other physical phenomena which are amenable to this method is given. [See also following Abstract.] H. M. B.

1058. Differential Analyser. New Machine for Solving Differential Equations. V. Bush. *Frank. Inst., J.* 212. *pp.* 447–488, *Oct.*, 1931.—It is found advantageous to use mechanical means of solving differential equations, and such a device for second order linear equations has recently been evolved by Bullard and Moon [see preceding Abstract]. In the present paper a new machine is described for the solution of ordinary differential equations up to the sixth order. The general method underlying the development of this type of analysing device is given. The occurrence of various mechanical problems and the methods of overcoming them in order to obtain results correct to 1 in 1000 are discussed in detail. The general method of placing an equation on the machine is presented and illustrated. Finally, a brief discussion is given of the method of successive approximation for obtaining solutions of high accuracy, a method for avoiding difficulties due to singularities in coefficients and a treatment of the problem of obtaining critical values of a parameter in an equation. H. M. B.

1059. Thomas-Fermi Equation Solution by the Differential Analyser. V. Bush and S. H. Caldwell. *Phys. Rev.* 38. *pp.* 1898–1902, *Nov.* 15, 1931.—A numerical solution of the Thomas–Fermi equation $d^2\phi/dx^2 = \phi^{3/2}/x^{1/2}$, with the boundary conditions $\phi(0) = 1$ and $\phi(\infty) = 0$, is presented, as obtained mechanically by means of the differential analyser. This device for solving ordinary differential equations is described in a separate paper [see preceding Abstract]. The results are given for larger values of argument than have previously been reported, and at high values of argument precision has been improved. Over a part of the range previously published results are checked, and the entire range is checked by an independent integration. AUTHORS.

1060. Mechanical Integrators with Holonomic Relationships. B. Salomon. *Comptes Rendus,* 193. *pp.* 830–832, *Nov.* 9, 1931.—A mechanical system is considered which depends on the independent variables $q_1, q_2, \ldots q_n$. Assuming that 2T, the doubled kinetic energy, does not contain q_i, the latter is cyclic. If the generalised force ϕ_i is zero at every instant, the variable is "hidden" or "ignorable." The corresponding Lagrangean equation, integrated, is $\partial T/\partial \dot{q}_i = \text{const}$. This equation can serve as the basis of integrating machines. The case of a solid of revolution suspended at its centre of gravity is considered, and details of the construction of an integrator of any function $y = f(x)$, based on the above theory, are given. N. D.

1061. Curve-Fitting by Least Squares. W. R. Cook. *Phil. Mag.* 12. *pp.* 1025–1039, *Nov.*, 1931.—A mathematical investigation of the probable errors of the constants deduced when a curve is fitted by least squares to a set of observations in which neither variable can be regarded as exactly known. J. H. A.



1062. Pressure Reduction Valve for Vacuum Work. W. Klose. *Zeits. f. techn. Physik*, 12. 11. *p.* 558, 1931.—Describes a valve by means of which gas can be introduced at a small rate of flow, which after regulation can be kept constant for several hours. Some gas is introduced through the capillary 1 and the cock 2 into the measuring glass 3, the pressure in which is measured by the manometer 4. The proper volume of gas is then led through 5 into the vessel 6, the pressure in which is read by means of another manometer, 7. Attached to 6 is a small tube 8, containing a fused-in rod of magnesia. The gas diffuses through this rod 9 into the apparatus. To shut off the flow of gas, some gas is passed in along 1, 2, 3 and 10, which raises the mercury and closes 8 and 9. E. E. F. d'A.

1063. Limiting Density of Matter. W. Anderson. *Phil. Mag.* 12. *pp.* 832–833, *Oct.*, 1931.—It is shown by two separate arguments that there is no upper limit to the density of matter, one based on compressibility and the other obtained by considering a collision between two bodies having the supposed maximum density. A. C. M.

1064. Density and Surface Tension of the Isomers of 2-Pentene and 2-Methyl-2-Butene. W. F. Seyer. *Am. Chem. Soc., J.* 53. *pp.* 3588–3596, *Oct.*, 1931.—The densities and surface tensions of the two 2-isomers of 2-pentene and 2-methyl-2-butene have been measured over a range of temperature of 150° C., whereby it is found that the total surface energies of the three compounds differ considerably at different temperatures. The observed parachor agrees tolerably well with the calculated value but shows a decrease with rise in temperature. The Eötvös or Ramsay-Shields constant is higher than the normal. H. H. Ho.

1065. Improvement in the Measurement of Surface Tension by the Ring Method, and Surface Tension of Dilute Salt Solutions. G. Schwenker. *Ann. d. Physik*, 11. 5. *pp.* 525–557, *Oct.* 27, 1931.—This method is capable of refinement to yield results accurate to ± 0·022 %, or, if the immersed ring is used only for comparative measurements, to ± 0·011 %. Determinations with pure water show that the accuracy of the method cannot be fully realised, owing to the disturbing influence of traces of volatile substances or of variation in the air-content of the water; the degree of accuracy is thus reduced to ± 0·044 %. At 0° the value 75·59 and at 18° 72·86 dynes per sq. cm. is obtained. For lithium, sodium and potassium chloride solutions of 0 to about 0·15 *N* concentration, the values of the surface tension are the same at equivalent concentrations. On the basis of Lenard's views on the formation of the surface layer, an interpretation of Heydweiller's curves [see Abstract 1784 (1910)] is given, complete agreement being shown between the expected and the experimental results. It is found also that, with completely dissociated solutions, the volume of the ions (complete molecules) in the surface layer is proportional to their mass and that there can be no question of a specific influence of the sign of the charge of the ions on the increase of surface tension. Thus, the ions investigated in dilute aqueous solutions consist mainly of the same substance (water). T. H. P.

1066. Capillary Conduction of Liquids through Porous Media. L. A. Richards. *Physics*, 1. *pp.* 318–333, *Nov.*, 1931.—The flow of liquids in unsaturated porous media follows the ordinary laws of hydrodynamics, the motion being produced by gravity and the pressure gradient force acting in the liquid. By making use of Darcey's law, that flow is proportional to the forces producing flow, the equation $K\nabla^2\psi + \nabla K \cdot \nabla\psi + g\partial K/\partial z = -\rho_s A\partial\psi/\partial t$ may be derived for the capillary conduction of liquids in porous media. It is possible experimentally to determine the capillary potential $\psi = \int dp/\rho$, the capillary conductivity K, which is defined by the flow equation $q = K(g - \nabla\psi)$, and the capillary capacity A, which is the rate of change of the liquid content of the medium with respect to ψ. These variables are analogous, respectively, to the temperature, thermal conductivity and thermal capacity in the case of heat flow. Data are presented, and application of the equations is made, for the capillary conduction of water through soil and clay, but the mathematical expressions and the experimental methods developed may be used to express capillary flow for other liquids and media. The possible existence of a hysteresis effect between the capillary potential and moisture content of a porous medium is considered. AUTHOR.

1067. Orientation of Surface Molecules in Neutralising Varnishes. P. Woog, J. Givaudon and Emilie Ganster. *Comptes Rendus*, 193. *pp.* 1001–1003, *Nov.* 23, 1931.—Woog has pointed out [see Abstract 1711 (1930)] that it is possible to neutralise the tendency of oil to spread on solid surfaces by means of a thin film, formed of polar molecules of a so-called neutralising substance, with regular orientation. This neutralises the superficial fields of force. When such a substance is mixed with a varnish, and applied to a solid, its molecules are held between the other molecules of the varnish when the solvent evaporates, and the surface layer is not regularly orientated. The authors find, however, that if the surface is then rubbed with the palm of the hand, or with a chamois leather, a drop of oil placed on it will no longer spread over it. Certain varnishes become soft when heated to 100° C. This enables the surface active molecules to form a properly arranged surface film, and when the whole is cooled down it is found that a drop of oil no longer spreads over the surface. H. N. A.

1068. Balanced-Layer Theory of Liquid Film Formation. C. W. Foulk and J. N. Miller. *Indust. and Engin. Chem.* 23. *pp.* 1283–1288, *Nov.*, 1931.—In this article are given: a restatement of the balanced-layer theory of liquid film formation; a description of two new forms of apparatus for studying film formation; a discussion, with data, on the relation of the static and dynamic surface tensions of a solution to the sign and the magnitude of the surface adsorption; various tables giving data to show the interdependence of the difference between static and dynamic surface tension, foaminess and tendency towards film formation of solutions. AUTHORS.

1069. Measurement of the Viscosity of Gases at High Pressures. Viscosity of Nitrogen to 1000 Atmospheres. A. Michels and R. O. Gibson. *Roy. Soc., Proc.* 134. *pp.* 288–307, *Nov.* 3, 1931.—A description is given of a method for measuring the viscosities of gases at high pressures. The method depends on the transpiration of gas through a capillary. A detailed account is given of the apparatus and of the method of calculating the viscosity from the experimental data. Results are given for the viscosity of nitrogen at 25°, 50° and 75° C. up to 1000 atmospheres. AUTHORS.

1070. Comparison of Viscosity and Molecular Arrangement in Liquid Octyl Alcohols. G. W. Stewart and R. L. Edwards. *Phys. Rev.* 38. *pp.* 1575–1582, *Nov.* 1, 1931.—A comparison is made between the X-ray diffraction haloes of 22 octyl alcohols and their corresponding viscosities and an unmistakable correlation found. The assumptions are that the haloes indicate periodicities, that the periodicities may be interpreted as structural in the " cybotactic " groups, and that the relative diffraction intensity of the haloes computed by assuming crystal structure may be used to estimate roughly the perfection of the liquid groups. It thus is shown that there is a correlation between the coefficient of viscosity and the perfection of grouping in the direction of the length of the chain molecules. This corresponds with the reasonable view that the viscosity within the liquid groups is caused by longitudinal slippage. Moreover, since the groups at any instant occupy a large fraction of the volume of the liquid, this viscosity is an important part of that measured. This interpretation accounts for the negative temperature coefficient of the viscosity, since the size of the groups decreases with temperature. The experiments and conclusions are in accord with Andrade's theory of momentary " crystallisation " and with Ornstein's theory of the formation of liquid crystal groups, yet it is to be noted that these theories deal with different aspects and not the entire phenomenon. AUTHORS.

1071. Damping Liquids for Aircraft Instruments. M. R. Houseman and G. H. Keulegan. *Am. Nat. Advis. Comm. for Aeronautics, Report No.* 398. [19 *pp.*], 1931.—Gives data on the kinematic viscosity (ratio of viscosity to density) in the temperature range − 50° to + 30° C. for a number of pure liquids and for solutions of animal oils, vegetable oils, mineral oils, glycerin and ethylene glycol in various solvents with low freezing points. The thermal coefficient of kinematic viscosity, expressed as a function of the kinematic viscosity of the solutions of glycerin and of ethylene glycol in alcohol, is practically independent of the temperature and of the chemical composition of the various liquids. This is equally true for the mineral oil group and for the pure animal and vegetable oils. An investigation has also been carried out to determine the efficiency of β-naphthol, hydroquinone and diphenylamine to inhibit the change of viscosity of poppy-seed and linseed oils. J. W. T. W.

1072. Determination of the Characteristics of Viscous Growth of Metals by Heating. G. Ranque and P. Henry. *Comptes Rendus,* 193. *pp.* 1061–1063, *Nov.* 30, 1931.—Three methods are available to determine the viscous phenomena of metals at high temperature depending on the variables, charge, lengthening, time and temperature. Particulars are given of a form of apparatus based on Kohn's method but modified to avoid errors arising in its original form. Results obtained with Armco iron are given in a table and they can be represented by a relation connecting the decrease of temperature with constant charge as a logarithm of the time in the form $\theta = 575 - 32 \cdot 5 \log (t + 3 \cdot 45)$. The rate of flow of the metal can thus be deduced at different temperatures and the logarithm of the flow at constant charge related to the temperature. By extrapolation to 10^4 hours the total growth under 6 kg./mm.^{2} is 158 per 100 at 550°, 0·65 per 100 at 475° and 0·003 per 100 at 400° C. The practical limit of viscosity, a flow of $< 0 \cdot 005$ per 100 per hour, can be found from the temperature-charge curve representing this limit up to 700°. R. S. R.

1073. Unique Character of the Solution of Friction Problems. R. Mazet. *Comptes Rendus,* 173. *pp.* 986–989, *Nov.* 23, 1931.—The mathematical theory of the motion of a solid subjected to given forces and in contact with a fixed object is developed in a manner which includes the cases of sliding motion, pure rolling motion, rolling and slipping motion combined and cessation of contact with the fixed object in one solution. J. S. G. T.

1074. Laminar Movements of Viscous Liquids. Part II. A. Rosenblatt. *Accad. Lincei, Atti,* 14. *pp.* 184–191, *Sept.,* 1931.—Continues the mathematical discussion [see Abstract 296 (1932)] and deals with perturbations vanishing at infinity. E. E. F. d'A.

1075. Motion of a Viscous Fluid near a Disc Oscillating about its Axis. A. Foch and J. Bariol. *Comptes Rendus,* 193. *pp.* 835–836, *Nov.* 9, 1931.—In the case of a disc oscillating in glycerin after the manner commonly employed for the determination of the viscosity of fluids, the authors have confirmed photographically that for fluid motion in cases where the Reynolds number is less than 60, the motion of the fluid particles is a circular one and occurs in planes parallel to the disc, the various planes rotating as a whole. The angular amplitude of the motion of different planes decreases exponentially with increase of distance from the disc. When the Reynolds number of the fluid motion exceeds 60 a new type of motion occurs in which there is actual displacement of fluid. For still higher values of the Reynolds number the motion becomes turbulent. J. S. G. T.

1076. Undeformable Plane Vortices. L. S. da Rios. *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 720–731, 1930–1931.—The problem of undeformable plane vortices is re-examined. Three types of vortices with rigid rotatory movement are found. A. D.

1077. Formation of Vortices from a Surface of Discontinuity. L. Rosenhead. *Roy. Soc., Proc.* 134. *pp.* 170–192, *Nov.* 3, 1931.—The flow of a stream of liquid above a stream of liquid of the same density and with equal velocity in the opposite direction is investigated by the method of small oscillations; the disturbed surface of separation is regarded as a sine curve of small amplitude. The solution contains two terms. The first order term, which corresponds with Rayleigh's original solution, represents a sine curve of continuously increasing amplitude, whilst the second order term, which ultimately predominates, introduces a disturbance antisymmetrical with respect to a crest; the surface of discontinuity, therefore, does not grow symmetrically. The Rayleigh method is applicable only during the first stages of flow. The motion has been investigated also by means of an approximate numerical method, which shows that the effect of instability upon a sine form surface of discontinuity is to produce concentrations of vorticity at equal intervals along the surface, and that the surface tends to roll up round these points of concentration with an accompanying increase of the amplitude of displacement. Diffusion effects retard the rolling-up process. H. F. G.

1078. Lines of Slip on a Cylinder. C. Woronetz. *Comptes Rendus,* 193. *pp.* 989–992, *Nov.* 23, 1931.—The problem of the flow of an infinitely thin sheet of fluid about a cylinder, previously treated by Noether, Oseen, Riabouchinsky, Villat and others, is briefly discussed mathematically. J. S. G. T.

1079. Periodic Waves on the Surface of Water. J. Baurand. *Comptes Rendus,* 193. *pp.* 992–994, *Nov.* 23, 1931.—In continuation of previous work [see Abstract 2898 (1928)], the author discusses experimental values of the velocity of propagation of small waves on water contained in a dish. Kelvin's formulæ for the velocity and period of ripples are verified approximately by the results. J. S. G. T.

1080. Aerodynamics of Body in Flight with Thermodynamic Propulsive Effects. G. A. Crocco. *Accad. Lincei, Atti,* 14. *pp.* 161–166, *Sept.,* 1931.—A further treatment [see Abstract 300 (1932)] of the problem of a body in flight when the external air is permitted to enter the body and is there raised in temperature before re-emission. The resulting increase in the velocity with which the air leaves the body may result in a reactive force which is sufficient to neutralise the resistance of the body to flight, or even to exert a definite force of propulsion. J. W. T. W.

1081. Solutions of the Boundary-Layer Equations in Aerodynamics. V. M. Falkner and (Miss) S. W. Skan. *Phil. Mag.* 12. *pp.* 865–896, *Nov.,* 1931.—When a body is immersed in a viscous fluid and the Reynolds number is high, the phenomena associated with viscosity occur almost wholly in a thin layer adjacent to the boundary. The boundary-layer equations applicable in this region are treated in this paper and a particular solution is given for the case when the tangential velocity at the outer limit of the boundary layer is proportional to a power of the distance measured along the boundary from the stagnation point. The results are given graphically for a range of values of the index. The general solution of the boundary-layer equations reduces to the particular solution described as the stagnation point is approached. This particular solution is used as a basis for two approximations to the solution in the general case; the second of these gives the correct value of the surface friction. These solutions are given graphically and the method of application to problems is described. The calculated and experimental values of the tangential velocity in the boundary layer are found to agree closely for a flat plate and a cylinder, and good agreement is also found for the surface friction in the case of a cylinder. J. W. T. W.

1082. Experimental Investigations on the Diffusion of Liquids. E. Münter. *Ann. d. Physik*, 11. 5. *pp.* 558–578, *Oct.* 27, 1931.—A photographic method for determining concentration gradients is described, and the theory of the paths followed by the rays is worked out. The method has been tested on three pairs of liquids, the results obtained agreeing well with those furnished by the float method. This optical method has the advantage that the diffusion process may be studied over the whole range of concentrations and over short periods. T. H. P.

1083. Measurements of Damping of Vibrating Steel Rods. D. Schenk. *Zeits. f. Physik*, 72. 1–2. *pp.* 54–67, *Oct.* 5, 1931.—The mechanical vibrations of electrically excited steel rods are examined by attaching piezoelectric quartz plates and measuring the amplitudes of the alternating potentials produced. In particular the damping of the vibrations, *i.e.*, the logarithmic decrement, is measured in various circumstances and by various methods. It is found to depend upon the amplitude, upon preliminary treatment and upon the time-interval between successive measurements. It does not seem possible to express these relationships quantitatively. That the alteration of the damping properties is closely related to structural alterations has been confirmed by X-ray measurements. N. D.

1084. Current Problems of Mechanical Vibrations. W. Adrian. *Zeits. f. angew. Math. u. Mechanik*, 11. *pp.* 382–383, *Oct.*, 1931.—A report of the meeting of the Committee on Mechanical Vibration of the Association of German Engineers, held in May, 1931. The work outlined and discussed includes that of Pöschl on the vibration of beams and that of Klotter on vibrations in systems in which the elasticity is variable. The vibrations of fibres, rods, plates and membranes is discussed. Reiher's work on the vibrations produced by traffic and on vibrations in structures is discussed in relation to the form, frequency and permissible limits of oscillation which may be detrimental to the building or to the persons therein. Much research is being carried out on fatigue and some details are given of Isemer's work on screws and that of Hoffmann on the occurrence of polydimensional mechanical vibrations—a hitherto neglected sphere except as regards the calibration of tuning forks. More than 20 other papers, dealing with research on vibrations in structures, vehicles and machines and with testing apparatus and instruments are noted. H. F. G.

1085. Experimental Study of Rigid Frameworks by a Method of Forced Vibrations. P. le Rolland and P. Sorin. *Rev. de Mét.* 28. *pp.* 617–630, *Nov.*, 1931.—In many arrangements of frameworks, it is difficult to estimate the modulus of rigidity of the system by statical methods. If a heavy simple pendulum acts through the framework to force a second identical pendulum to vibrate, a flux of energy will pass backwards and forwards between the pendulums; from the free period of one pendulum and the period of the flux of energy the rigidity modulus and Young's modulus of the framework can be calculated. The amount and rapidity of the flexure are so small that the method is equivalent to a statical one. A simple case, of which the elastic properties are known, is first taken, then a study is made of systems under various conditions to find, for example, the effect of horizontal transverse bars at different positions on a vertical frame. It is found that, if a system is subjected to an eccentric alternating couple at a frequency of about 1000 per min., causing a displacement of about 3 mm., the rigidity remains unaltered for several thousands of vibrations and then rapidly drops to zero. Diagrams show this effect very clearly. H. M. B.

1086. Brownian Motion of Strings and Elastic Rods. G. A. van Lear, Jr., and G. E. Uhlenbeck. *Phys. Rev.* 38. *pp.* 1583–1598, *Nov.* 1, 1931.—The method introduced by Ornstein [see Abstract 2142 (1927)] is applied to calculate the Brownian-motion mean-square deviation for strings and for elastic rods, the surrounding medium being a gas. For the string, a varying tension and elastic binding at the ends are supposed, and a formula is obtained for the mean-square deviation of any point at time t, having started with a given deviation of that point; the result contains infinite series. This result is specialised to the string with fixed ends and constant tension. For the mid-point, and for a limited time interval, the series are summed; for $t \to \infty$, the result is given for all points, agreeing with that given by Ornstein for the mid-point. Elastic rods are treated similarly, and similar results are obtained. The effect of gravity, when the rod is vertical, is introduced by a simple and consequent perturbation method, and a formula is obtained for the mean-square deviation of the lower end; this agrees closely with Houdijk's experimental results. The time dependence given by the complete formula cannot yet be tested, for Houdijk gives only long-time mean values in his publication. AUTHORS.

1087. Determination of Young's Modulus from Flexural Oscillations. E. Goens. *Ann. d. Physik,* 11. 6. *pp.* 649–678, *Nov.* 10, 1931.—Timoschenko's more complete differential equation for flexural oscillations in a bar [see Abstract 1512 (1921)], differing from Rayleigh's by the inclusion of shear stress, is solved for the case of a bar free at both ends. Approximate formulæ, more suited to the practical determination of Young's modulus, and applicable to several overtones, are then derived, and tested by observations on specimens of steel and aluminium. The fundamental frequencies, and those of the first five or six overtones, are measured by comparison with a standard source of sound. The various values of Young's modulus thus calculable for a specimen are consistent if the new approximation, but not if Rayleigh's formula, is employed. It is now possible, therefore, to measure Young's modulus accurately by the method of flexural vibrations. J. P. A.

1088. Stresses in a Notched Bar under Tension. W. Kuntze. *Zeits. f. Physik,* 72. 11–12. *pp.* 785–792, *Nov.* 16, 1931.—A cylindrical bar of metal has a V-shaped groove cut round it in a plane perpendicular to the axis. By means of a special extensometer, the change in the diameter d of the reduced section is determined when the bar is subjected to a tension P parallel to its axis. For a constant value of $\sigma = 4\mathrm{P}/\pi d^2$, the quantity $\alpha = \dfrac{\Delta d}{d}\,\sigma$ is a linear function of the reduced area $\pi d^2/4$. α changes sign, becoming positive for deep grooves, and in the limiting case of a groove penetrating to the axis, the extension per unit length, along the diameter, tends to be equal to that along the axis. Search for an explanation of this uniform dilation at the axis reveals that forces in the nature of reactions must be taken into account. As these cannot accurately be specified, tests on notched bars cannot yield definite conclusions as to the stresses over the section. J. P. A.

1089. Time and Stress in the Mechanics of Homogeneous Media. H. Schlechtweg. *Zeits. f. Physik,* 72. 11–12. *pp.* 811–821, *Nov.* 16. 1931.—Discusses various generalisations of Hooke's law which have been proposed either to deal with the effect of time or of large stresses. J. H. A.

1090. Strength and Elastic Properties of Wet Salt Crystals. Part II. Effect of Different Solvents and the Forms of the Dissolved Crystals. E. Rexer. *Zeits. f. Physik.* 72. 9–10. *pp.* 613–620, *Oct.* 30, 1931.—It is shown that the increase in plasticity and of strength of NaCl and KI crystals, which are in process of solution under comparable experimental conditions, agree quantitatively. This is true both for physical solvents, such as H_2O and CH_3OH, and also for chemical solvents, such as 100 % H_2SO_4 and H_2SO_4 + 25 % SO_3. [For Part I see Heine, Abstract 2918 (1931).] H. N. A.

1091. Adiabatic Invariant in the Free Motion of a Gyroscope. G. Krall. *Accad. Lincei, Atti,* 14. *pp.* 179–184, *Sept.,* 1931.—Considers the free motion of a gyroscope subject to slowly varying influences involving the inertial constants of the system or the so-called moments corresponding to the " unknowable " co-ordinates of the body. Obtains the invariant $W/2\pi = K(1 - \cos \omega)$, where ω is the smaller of the two angles made by the vector moment of the quantity of motion K with an axis fixed with respect to the axis of the figure. E. E. F. d'A.

1092. Gyro-Compass and Perturbing Couples. N. Carrara. *N. Cimento,* 8. *pp.* 298–309, *Aug.–Sept.–Oct.,* 1931.—The theory is worked out for Foucault's gyro-compass, and a suspended gyro-compass, constructed for naval gunnery purposes, acted upon by various couples. A. D.

1093. Alkali Hydrides. E. Zintl and A. Harder. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 265–284, *Oct.,* 1931.—Apparatus for the preparation, analysis and X-ray examination, by the powder method, of hydrides of the alkali metals with exclusion of air, is described. All these hydrides have the sodium chloride structure with the following lattice constants: LiH 4·084; NaH 4·880; KH 5·700; RbH 6·037; CsH 6·376 Å. The corresponding densities are calculated to be 0·77, 1·36, 1·43, 2·59 and 3·41 respectively. Intensity measurements of the X-ray interference do not support Hüttig's view that the negative H-ions are freely mobile in the lattice. With the help of Goldschmidt's ionic radii, the effective radius of the hydride ion H^- is found to vary from 1·26 Å. in LiH to 1·54 Å. in CsH. Examination of the band spectra shows that the internuclear distances in gaseous LiH and NaH are about 30 % less than in the lattices. The analogy between these hydrides and the corresponding halides, especially the fluorides, is shown by the crystallographic resemblance of LiH to LiF, the lattice constants of which differ by only 1·5 %. The two compounds are not completely miscible in the solid state, but a slight line-displacement in the interference diagram indicates the probability that the fluoride is able to take up the hydride with formation of mixed crystals. T. H. P.

1094. Evidence for the Secondary Structure of Lithium Fluoride by Atomic Diffraction. T. H. Johnson. *Frank. Inst., J.* 212. *pp.* 507–514, *Oct.*, 1931.—An experimental contribution to the theories of Smekal and Zwicky relating to structure-sensitive and structure-insensitive properties of crystals. Previous work has been mainly upon bismuth and metallic substances; this is the first attempt upon a simple binary salt; *i.e.*, LiF. A well-defined beam of atomic hydrogen is focussed upon a cleaved (100) surface of LiF. In addition to the primary spectrum (arising from the regular array of ions upon the surface), a secondary spectrum appears, corresponding to the effect which might be anticipated on Zwicky's view of blocks, or periodic changes of density. This interpretation is not taken as absolutely final. F. I. G. R.

1095. Empirical Crystal Radii for Ions with Inert Gas Configurations. W. H. Zachariasen. *Zeits. f. Krist.* 80. 3–4. *pp.* 137–153, *Oct.*, 1931. *In English.*—Radii of 45 elements are determined for coordination number 6, and Coulomb force between a univalent kation and a univalent anion. They are deduced from the most reliable observations, cases of crystals containing anion contacts are avoided, and the values of K^+, 1·334 Å., and Cl^-, 1·81 Å., taken as basic. Corrections for different coordination numbers (based on Born's expression for crystal energy), Coulomb forces (valency), and radius ratio are discussed and tabulated, and the results compared with previous determinations. [See Abstracts 1987 (1927) and 40 (1930).] C. A. S.

1096. Crystal Structure of Potassium Nitrate. D. A. Edwards. *Zeits. f. Krist.* 80. 3–4. *pp.* 154–163, *Oct.*, 1931. *In English.*—Potassium nitrate is orthorhombic holohedral, the unit cell has *a* 5·43, *b* 9·17, *c* 6·45 Å., and contains 4 molecules, space group V_h^{16}. The coordination number of potassium here is 9; the distance K–O averaging 2·88 ± 0·06 Å. The potassium, nitrogen and 4 oxygen atoms are on planes of symmetry, the other 8 oxygen atoms in general positions. The pseudohexagonal structure is due to the nitrogen atoms—each surrounded by three oxygens in the same plane—lying in lines parallel to the *c* axis. C. A. S.

1097. Crystal Structure of Potassium Chromate. W. H. Zachariasen and G. E. Ziegler. *Zeits. f. Krist.* 80. 3–4. *pp.* 164–173, *Oct.*, 1931. *In English.*—There are four molecules in the unit cell, of the following dimensions: $a = 5 \cdot 92$ Å., $b = 10 \cdot 40$ Å., $c = 7 \cdot 61$ Å. The space group is V_h^{16}, and the calculated density 2·73. Four O atoms surround each Cr atom tetrahedrally. The following salts are isomorphous with K_2CrO_4, indicating similar space groups and analogous structures: K_2SO_4, K_2SeO_4, Rb_2SO_4, Rb_2SeO_4, Rb_2CrO_4, Cs_2SO_4, Cs_2SeO_4, Cs_2CrO_4, $(NH_4)_2SO_4$, $(NH_4)_2SeO_4$, Tl_2SO_4, Tl_2SeO_4, K_2MnO_4. F. I. G. R.

1098. Rosickite, the Natural γ-Modification of Sulphur. J. Sekanina. *Zeits. f. Krist.* 80. 3–4. *pp.* 174–189, *Oct.*, 1931.—The author has established the natural occurrence of γ-sulphur and calls it rosickite. It has the same crystallographic properties as the artificial product, and is regarded as arising from pyrites by transformation. In addition to twin-lamellæ and contact-twins on {101}, rosickite shows gliding planes along (101), ($\bar{1}$01) and (001). F. I. G. R.

1099. Structure of the Complex Mercury Compounds Ag_2HgI_4 and Cu_2HgI_4. J. A. A. Ketelaar. *Zeits. f. Krist.* 80. 3–4. *pp.* 190–203, *Oct.*, 1931.—The two salts are isomorphous, and belong to the tetragonal system. The parameters are: Ag_2HgI_4, $a = 6 \cdot 340 \pm 0 \cdot 005$ Å., $c/a = 1 \cdot 000 \pm 0 \cdot 005$; Cu_2HgI_4, $a = 6 \cdot 08 \pm 0 \cdot 01$ Å., $c = 6 \cdot 135 \pm 0 \cdot 01$ Å., $c/a = 1 \cdot 009$. The space group is V_d^1. The iodine atoms are practically in cubical dense-packing formation. The structure is related to that of zincblende. F. I. G. R.

1100. Structure of Methyl Silicate. W. Eulitz. *Zeits. f. Krist.* 80. 3–4. *pp.* 204–237, *Oct.*, 1931.—The compound melts at about − 4° C. There appear to be two modifications, one cubic and one of lower symmetry, the latter being unstable. The cubic form, at low temperatures, shows an elementary cell of edge-length 9·85 Å., and contains four molecules of $(CH_3)_4SiO_4$. F. I. G. R.

1101. Habit Variation in Crystals of Potassium Permanganate. H. E. Buckley. *Zeits. f. Krist.* 80. 3–4. *pp.* 238–254, *Oct.*, 1931. *In English.*—The predominant effect of the following ions in solutions from which potassium permanganate is crystallising are: (*a*) NO_3' (similar to that of ClO_3', Cr_2O_7'' and S_2O_6''), causes enlargement of {001}; (*b*) PO_4'', AsO_4'' and H_2AsO_4', enlarge {100} and {011} equally; (*c*) H_2PO_4' and CO_3'' enlarge {100} more than {011}; (*d*) HPO_4'', $HAsO_4''$ and MnO_4'' enlarge {100} less than {011}; (*e*) B_4O_7'' and BrO_3' no effect. Explanations based on the structures of the various salts added are discussed, and many inconsistencies in their recorded dimensions pointed out. [See also Abstract 26 (1932).] C. A. S.

1102. Crystal Structure of Molybdenum Trioxide. Nora Wooster. *Zeits. f. Krist.* 80. 5–6. *pp.* 504–512, *Nov.*, 1931. *In English.*—The unit cell of MoO_3 has (*a*) 3·92, (*b*) 13·94, (*c*) 3·66 Å., and contains 4 mols.; space group (*bnm*), Q_h^{16}. The structure is a layer lattice parallel to (010), consisting of parallel chains of distorted octahedra of O-ions surrounding the Mo-ions. The distance Mo–O varies from 1·90 to 2·34 Å., O–O from 2·75 to 3·75 Å. The parameters of the Mo-ions are $u = 31°$, $v = 35° \ 30'$; those of the O-ions $u = 31°$, $v = 35° \ 30'$, $v' = 90°$, $y = 25°$. C. A. S.

1103. Crystallised Boron. L. Hackspill, A. Stieber and R. Hocart. *Comptes Rendus*, 193. *pp.* 776–778, *Nov.* 3, 1931.—A very condensed h.f. spark is passed between electrodes of Mo or W in a mixture of hydrogen and vapour of boron trichloride. With 300 watts 0·5 gm. boron is obtained in 4 hours as a metallic-looking product, somewhat resembling arsenic, hardness 9 (Mohs), d^{20} 2·33. (A subsequent corrigendum gives this figure instead of the 3·33 in the paper itself.) Aqua regia attacks it at 120°; and it is approximately 99 % pure. X-ray examination shows it to be probably hexagonal. The product obtained by the action of incandescent tungsten on vapour of boron tribromide has a similar structure, but not the aluminium borocarbide usually known as "crystalline boron," containing 80–82 % B. C. A. S.

1104. Rate of Crystallisation of Different Forms of Dimethyl Tartrate. G. Rumeau. *Comptes Rendus*, 193. *pp.* 1085–1087, *Nov.* 30, 1931.—Considerable differences in the rates of crystallisation found for samples of *d*- and *l*-rotatory dimethyl tartrate led to the identification of two forms, α_1 and α_2, melting respectively just under 48° and just above 50° for both kinds. The speeds of crystallisation were measured over the temperature range 10° to 45°, the maximum being at 25°. Of the two forms α_1 is very unstable. A further form, β, melting at 60°, found by Patterson, has a speed different from the other samples and is very stable.

Differences of rotatory powers in methyl alcohol solutions could not be established nor a transformation of one kind into the other. The results are similar to those of Weissberger and Sängewald for solutions in benzene of the β and a mixture of α_1 and α_2. It is assumed that the results are due to polymorphic modifications. R. S. R.

1105. Revision of Atomic Weight of Thallium. H. V. A. Briscoe, S. Kikuchi and J. B. Peel. *Roy. Soc., Proc.* **133.** *pp.* **440–457,** *Oct.* **1, 1931.**—The method used was the precipitation of silver chloride from silver nitrate by adding thallous chloride. Twenty-two determinations were made, using thallium procured in England and in Germany, the latter being obtained as a by-product in the burning of pyrites from mines at Meggers in Westphalia. The mean value for the atomic weight obtained was Tl = 204·34, with an average deviation ± 0·015. This agrees well with the value obtained by Hõnigschmid, Birckenbach and Kothe, Tl = 204·39, with much the same deviation of the individual analyses from the mean. The latter authors also determined the ratio TlCl : Ag or TlCl : AgCl. These determinations, taken together, completely outweigh all previous values, including that of Crookes, Tl = 204·04. The authors suggest that the true value is probably within one or two hundredths of a unit of the mean value 204·37. From the probable value of the " packing fraction " it appears that if thallium were a " simple " element its atomic weight should be nearly a whole number, and, though no isotopes have been found by the positive ray method, it appears that thallium is very probably a mixture of two or more isotopes. H. N. A.

1106. Chlorine Isotope Cl^{39}. G. Hettner and J. Böhme. *Zeits. f. Physik,* **72. 1–2.** *pp.* **95–101,** *Oct.* **5, 1931.**—Describes how the HCl band near 1·76μ was investigated with a Wood's echelette grating spectrometer, using concave mirrors and a Hettner radiometer. The grating had 142 lines per mm., and gave a high dispersion. There appears to be no doubt of the existence, in addition to the isotopes Cl^{35} and Cl^{37}, of a certain amount of Cl^{39}. There are even indications of some of the isotope Cl^{40} in the observed spectrum. Neither of the last two isotopes was observed by Aston with the mass spectrograph. H. N. A.

1107. Stability of Atoms. G. Kirsch. *Pont. Accad. Sci., N. Lincei, Atti,* **84.** *pp.* **693–708, 1930–1931.** *In German.*—The author discusses, as far as present knowledge permits, whether the stability of the atoms depends on the varying nuclear structure or upon the arrangement of the extranuclear electrons. The conclusion is formed that, in the main, the latter is responsible for the degree of stability of the nucleus, and it is pointed out that in Hund's table, showing the arrangement of the electron shells, there is evidence that certain combinations of orbits are conducive to stability, and to a high concentration of the particular elements in the lithosphere, in meteorites, in the sun and in stars; other combinations are conducive to instability and low concentration. The theory suggested is that if the orbits are so related to one another that the resultant field produced by them at the nucleus is small, the latter will be more stable than if it is large. An odd number of electrons (odd atomic numbers) will mean that there will be at least one orbit which is unbalanced; the other orbits may be in pairs, with the electrons rotating in opposite directions, and producing zero magnetic field at the centre, but the odd orbit will produce a field which may render the nucleus less stable. With even atomic numbers certain distributions of the orbits conduce to stability, as in the alkaline earth metals. The theory leads to the suggestion that the birthplace of the elements is in the interstellar spaces, where they will form extremely rarefied gases composed of neutral atoms. H. N. A.

1108. Coupled Duplet and Octet. A. F. Richter. *Phil. Mag.* 12. *pp.* 764–768, *Oct.*, 1931.—Distinctive groups of electrons are divided into three classes in which the degree of stability is due mainly to the neutralisation of mechanical and magnetic moments. If the outer shell has lost some of its stability mutual neutralisation with the next group causes stronger coherence or coupling of the two groups. By this coupling of systems may be explained the characteristic course of the curves of ionisation potential and of the chemical properties of the elements concerned. [See also following Abstract.] G. E. A.

1109. Three Different Effects of Conjugation. A. F. Richter. *Phil. Mag.* 12. *pp.* 768–770, *Oct.*, 1931.—When a group of electrons or atoms is in a state of non-saturation it tends to conjoin with another similar group. Such conjugation may be intra-atomic, inner-molecular or extra-molecular. The first kind has been referred to [see preceding Abstract]; the second is that known and studied by organic and atomic chemists. When inner-molecular conjugation cannot take place, the unsaturated molecule tends to conjugate with another molecule in the presence of hydrogen nuclei. G. E. A.

1110. Conditions for Identical Orbits of Two Charged Particles of Unequal Mass and Charge. W. F. G. Swann. *Frank. Inst., J.* 212. *pp.* 439–445, *Oct.*, 1931.—The conditions that particles of masses m_1 and m_2 and charges e_1 and e_2 starting from the same points will describe identical orbits are: (1) That the initial vector velocities W_1 and W_2 of the particles are related at the initial instant by $\frac{m_1}{e_1}W_1 = \frac{m_2}{e_2}W_2$. (2) That at the same point, but at corresponding times given by $m_1e_2t_1 = m_2e_1t_2$, the electric fields are related by the condition $m_2e_1E_2 = m_1e_2E_1$ and the magnetic fields by the condition $H_2 = H_1$. If these conditions are satisfied, the fields may vary in any manner whatever with x, y, z and t. J. E. K.

1111. Molecular Beams. J. B. Taylor. *Indust. and Engin. Chem.* 23. *pp.* 1228–1231, *Nov.*, 1931.—Molecular beams, narrow rays of molecules formed by a slit system and moving in one direction in an evacuated apparatus, may be used to advantage in many types of research. Among those described or suggested are determinations of molecular velocities, mean free paths, magnetic and electrical moments, degree and heat of dissociation, vapour pressures, types of reflection, heats of adsorption, character of surfaces, and chemical reaction products and mechanisms. The formation and the detection of the beams are described. AUTHOR.

1112. Quantum Treatment of the Benzene Problem. Part II. Induced Polarities. E. Hückel. *Zeits. f. Physik*, 72. 5–6. *pp.* 310–337, *Oct.* 21, 1931.—Based on the electronic structure of benzene discussed in Part I [see Abstract 3352 (1931)], a quantum theoretical foundation is now given in simple cases for the chemical behaviour of substituted benzenes, and certain deviations from Vorländer's rules have been thereby discovered. The theoretical treatment depends upon a disturbance calculation for the charge distribution of electrons in substituted benzenes. H. H. Ho.

1113. Valence Forces in Lithium and Beryllium. J. H. Bartlett, Jr., and W. H. Furry. *Phys. Rev.* 38. *pp.* 1615–1622, *Nov.* 1, 1931.—With the nodeless wave functions of Guillemin and Zener, the method of Heitler and London is applied to determine how two normal lithium atoms, and also two normal beryllium atoms, influence each other (as a function of the distance). For the diatomic lithium molecule in the ground state, the equilibrium distance is calculated to be 2·4 Å., and the heat of dissociation to be 1·09 volts. The experimental values are 2·67 Å. (Harvey and Jenkins) and 1·14 volts (Loomis and Nusbaum), respectively. Two normal beryllium atoms repel each other. AUTHORS.

1114. Many-Electron Wave Functions. J. H. Bartlett, Jr. *Phys. Rev.* 38. *pp.* 1623–1627, *Nov.* 1, 1931.—If it is possible to describe the state of an atom by the addition of several vectors, and if one assumes the wave function for any state of a configuration to be a linear combination of product functions for that configuration, then one can determine the coefficients in the linear combination by a simple method. Examples are given. The usual interval formula is not applicable for $2p^3$, where non-splitting is the case. [See also Abstract 2533 (1930).] AUTHOR.

1115. First Integrals of Dirac's Equation. A. Proca. *Comptes Rendus*, 193. *pp.* 642–644, *Oct.* 19, 1931.—If the derivative of an operator obeys the law $x\dot{\xi} = \mathrm{H}\xi - \xi\mathrm{H}$, where $x = h/2\pi i$, the equation $\xi =$ const. gives a first integral. In quantum mechanics we find integrals analogous to those of the Newtonian mechanics of a particle, *viz.*, the integrals of energy, momentum and moment of momentum. The differences between Dirac's and the classical electron are exhibited by new first integrals and conservation theorems, distinct from those just mentioned. The author discusses the properties of a vector R, which obeys the vector equation $[\overline{\mathrm{R}} \times \overline{p}] =$ const., where p is the momentum, and shows that this equation is another first integral of the motion of a free electron. The relationship of R with the spin is shown and the value of R is worked out. N. D.

1116. Dirac's Quantum Theory. D. Iwanenko. *Zeits. f. Physik*, 72. 9–10. *pp.* 621–624, *Oct.* 30, 1931.—To overcome the " negative energy " difficulty in relativistic quantum mechanics it is proposed that only averaged values of operators should be treated as observables. It is also pointed out that the theory implies a " minimum time-interval," and that therefore compatible observations in the sense of Dirac are impossible. [See also Abstract 704 (1932).] G. C. McV.

1117. Local Momentum in Wave Mechanics. L. A. Young. *Phys. Rev.* 38. *pp.* 1612–1614, *Nov.* 1, 1931.—The present paper shows the exact relations between dynamical quantities of classical theory and their wave-mechanical analogues. A new quantity, *local momentum*, is defined and discussed, and the Bohr quantum condition is revived in a form compatible with modern theory. AUTHOR.

1118. Relativistic Quantum Mechanics. G. Wataghin. *Zeits. f. Physik*, 73. 1–2. *pp.* 121–129, *Nov.* 24, 1931.—The author attempts to give a Lorentz invariant formulation of the quantum law, in which the time and space coordinates are treated in the same manner. Postulates that all the coefficients of a Lorentz transformation have the character of q numbers. Deals with the limits of accuracy of space and time measurements. Shows that the difficulty with regard to the presence of negative eigenvalues of the energy can now be avoided by means of Schrödinger's method. H. N. A.

1119. Physical Significance of Second-Order Terms in the (Schrödinger) Perturbation Theory. H. Jones. *Phil. Mag.* 12. *pp.* 1063–1072, *Nov.*, 1931.—The physical significance of developments of the perturbation theory by Lennard-Jones [see Abstract 1103 (1931)] is discussed. The change of energy of an electron on the application of an electric field, the energy of the hydrogen molecular ion, and the relation of binding energy to electrical conductivity of metals are briefly discussed from this standpoint. J. S. G. T.

1120. Origin of Inertial Mass. E. Reichenbächer. *Zeits. f. Physik*, 72. 7–8. *pp.* 553–556, *Oct.* 28, 1931.—A comparison of the wave equation discussed by the author in previous papers [see Abstract 747 (1931)] with that deduced from the Schrödinger–Gordon theory, leads to the conclusion that the so-called mass-component of the latter theory arises from a process of averaging over a distance comparable with the wave-length appropriate to the mass. Accordingly, natural laws are obeyed very closely only in the macroscopic discussion of phenomena, and where microscopic phenomena are concerned are of statistical application only. [See also following Abstract.] J. S. G. T.

1121. World Function in the Unified Action Integral of Gravitation, Electricity and Matter. E. Reichenbächer. Part II. *Zeits. f. Physik*, 72. 9–10. *pp.* 669–682, *Oct.* 30, 1931.—The author's theory developed in previous papers [see Abstract 747 (1931) and preceding Abstract] is extended by the consideration of the two " components " of the theory as semi-scalars, the gradient of which is a vector, while the product of the two wave-functions is a perfect scalar. A form of the world function is derived from the aggregates entering into the first-order wave equations. The theory explains the difference of the mass of the proton and electron. J. S. G. T.

1122. Evolution of the Universe. Discussion at British Association, 1931. *Nature*, 128. *pp.* 701–722, *Oct.* 24, 1931. *Supplement.*—**J. Jeans,** in opening the discussion, dealt with the increasing entropy of the universe, the origin of the cosmic rays, the annihilation of matter in the stars, and the discrepancy in the time-scales provided, on the one hand, by stellar evolution and, on the other, by the expansion of space. **G. Lemaître** discussed the expansion of the universe and supposed that cosmic rays were the by-products of the formation of the stars. **W. de Sitter** was of opinion that the expansion of the universe and the evolution of the universe were two independent processes going on side by side. **A. S. Eddington** announced his new discovery connecting the mass and charge of the electron with the radius of space and the number of particles in the universe. **R. A. Millikan** reviewed the experimental data with regard to cosmic rays and concluded that they originate by the building up of atoms in outer space. **E. A. Milne** dealt with Novæ and the light they shed on the evolution of stars. **J. C. Smuts, E. W. Barnes** and **O. J. Lodge** discussed the philosophic and religious aspects of modern physical theory. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

1123. Dust Content of the Atmosphere. H. H. Kimball and I. F. Hand. *Monthly Weather Rev.* 59. *pp.* 349–352, *Sept.*, 1931.—Measurements were made with an Owens dust counter in a sparsely settled but growing suburb of Washington from December, 1922, to June, 1931. Monthly average and annual totals show a gradual increase in dust content for 1923–28 and a slight decrease in the next two years. Solar radiation records indicate a decrease of intensity in the winter half-year (Nov.–April) when the dust content increases, but no decrease from normal in the warm half of the year. The maximum percentage increase in dust content is shown by the minimum in 1930 being double those in 1923 and 1924. The increase in local atmospheric dust has not yet been accompanied by a decreased visibility of distant objects. A relation has been found between the SO_2 and dust contents of the atmosphere. R. S. R.

1124. Atmospheric Ozone. F. W. P. Götz. *Gerlands Beitr. z. Geophys. Supplementband,* 1. *pp.* 180–235, 1931.—An account is given of the investigations made on the amount and position of ozone in the atmosphere. It is pointed out that in the middle of the last century ozone was found in the air by chemical means, and about 1879 spectroscopic investigations on the ultra-violet light which reaches the earth from the sun were started. The absorption due to ozone was measured by Hartley in 1880, and the so-called Hartley band in the ultra-violet was discovered; later, absorption bands were found in the visible and infra-red. Experiments show that the curtailing of the sun's spectrum is independent of the sun's atmosphere and is mainly due to ozone in the upper strata of the earth's atmosphere. Investigations have been carried out to find how the ozone content and the height of the ozone layer vary from day to night and with the seasons of the year. In 1926–28 Dobson spectrographs were set up at about twelve stations in different parts of the world, so that homogeneous results of proved excellence can now be obtained from widespread points of observation. A list of papers dealing more fully with the various aspects of the subject is appended. H. M. B.

1125. Maximum Intensity of Solar Rays at Nice and Thorenc in the Maritime Alps. L. Gorczynski. *Comptes Rendus,* 193. *pp.* 1108–1110, *Nov.* 30, 1931.—Observations were made at Nice and Thorenc from 1928 to 1931 with a thermoelectric pyrheliometer [see Abstract 2988 (1931)], and the instruments were calibrated frequently to avoid former errors. The values of the monthly maximum intensity of solar radiation normal to the rays are stated in gm. cal./$cm.^2$ min. and compared with those obtained by Brazier at Paris. Maxima are obtained in (1) March–May, and (2) September. The values for Nice exceed those for Paris, especially in winter, but the values for the high-level station at Thorenc are the greatest on account of its altitude. R. S. R.

1126. Atmospheric Transmission with an Overcast Sky of Mean Density. W. Smosarski. *Gerlands. Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 77–84, 1931.—The coefficient of transmission is found at Warsaw, Potsdam and Stockholm according to the sum of the insolation. The law is found to be similar to that under clear-sky conditions. Although it is generally cloudier in summer than winter, the coefficient is greater in the latter; it is also greater at Stockholm than at the other two stations, which are at about the same latitude as one another. H. M. B.

1127. Influence of the Surface of the Ground on the Light in the Earth's Atmosphere. A. Angström. *Gerlands. Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 123–130, 1931.—The intensity of the light at any place on the earth depends upon the quantity of unreflected light falling there and the amount of reflection from the ground and the atmosphere. It is found that, under any condition of atmosphere, the reflected light does not add more than 8 % to the direct light for forests, pasture land and so forth, but, when the ground is snow-covered, for a clear sky the increase is 20 % and for an overcast sky over 100 %. The colour of the light is also affected by reflection; air scatters the shorter wave-lengths more than the longer ones; woods, cliffs and so forth, under bright sunlight, give the light a definite tint. H. M. B.

1128. Evaporation. A. Wagner. *Gerlands Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 85–100, 1931.—Previous results are shown to be contradictory. The problem is considered as consisting of (*a*) emergence of vapour molecules from the water surface; (*b*) passage through the limiting layer by diffusion; and (*c*) removal of diffused vapour by mass exchange. Using results deduced for diffusion of heat, the velocity of evaporation is given by the expression

$$10^{-2}(e_0 - e_1)\sqrt{u + 0\cdot 3}\,.\,f_2(b)\,.\,f_3(\mathrm{T})\mathrm{g./cm.^2/hr.},$$

where e_0 is the vapour pressure at the evaporating surface, e_1 that in the air, u the wind velocity, e_1 and u being measured close to the surface of the earth, b the air pressure, and T the absolute temperature. Provided that $u \ngtr 4$ m./sec., and the height $\ngtr 3$ km., $f_2(b)$ approximately $= b_0/b$, and $f_3(\mathrm{T}) = \mathrm{T}/\mathrm{T}_0$, b_0, T_0 being pressure and absolute temperature at the height concerned. The method is applied to calculate the evaporation from a snow surface. C. A. S.

1129. Atmospheric Radioactivity and Weather. K. C. Wang. *Tsing Hua Univ., Sci. Reports,* 1. *pp.* 119–128, *Oct.,* 1931. *In English.*—The investigation was carried out in Peiping by a method similar to one employed by Deodhar. A wire at a high negative potential was exposed for exactly two hours, then carefully wound on a brass frame and placed in the ionising chamber of a gold-leaf electroscope. The unit of atmospheric activity is taken as the discharge produced by 1 m. of wire of 1 volt per hour of the electroscope. Results show radioactivity at Peiping greater than in Europe but less than in India. Rises and falls of the barometer are accompanied by decreases and increases in activity. Clouds, especially dense nimbus and cumulus, and east winds produce a decrease in activity. For other winds there is an increase. H. M. B.

1130. Modern Theories on the Origin and Structure of Cyclones. C. Fabris. *Com. Naz. Ital. Geodes. e Geofis., Publ. No.* 2. [106 *pp.*], 1931.—A careful study is made of the theories of Bjerknes on cyclones, with special reference to surfaces of discontinuity and the gravitational waves formed along these surfaces. The theory is compared with actual information on the distribution of pressure, winds and so forth in the atmosphere, and also with many theories (Fickner, Exner and so forth) in order to see if a common theory can be developed which will fit meteorological dynamics. The author considers that no theory or hypothesis so far developed is a rigid interpretation of atmospheric phenomena, but all the theories may be of some use in future work. A Bibliography is appended. H. M. B.

1131. Further Deductions from the Theory of the Symmetry Point. L. Weickmann. *Gerlands Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 244–251, 1931.—The author's theory of symmetrical pressure periods [see Lehmann, Abstract 3732 (1931)] is illustrated by pressure curves for the winters 1922–23 to 1929–30 at Leipzig and Croydon, and causes are suggested for the 24- and 36-day waves connected therewith. The former is attributed to the gradual development of temperature differences (during about 20 days) between neighbouring masses of cold (polar) air and warm (more southerly) air until a difference of about 20° is reached, when the cold air "erupts" into the hot, a phase lasting about 4 days. The 36-day period originates in N.E. Asia and travels westward, disappearing over the Gulf Stream; its existence is indicated by 18-day periods of wind direction, which points to connection with a free vibration period of the atmosphere, the wave being a Margules wave of the second kind, class 4 of type 4. C. A. S.

1132. Forms of Stratified Cloud. G. T. Walker. *Roy. Meteorolog. Soc., J.* 57. *pp.* 413–419; *Disc.,* 419–421, *Oct.,* 1931.—The opinions of Weber and Benard are reviewed regarding the hexagonal forms which are produced when an unstable layer of a stationary liquid breaks up and vortices are formed, and the experiments are repeated. With heated spermaceti and Al powder and with a channel of alcohol and Al powder the transverse and polygonal forms and strips are obtained. Photographs of clouds illustrate these patterns. Mal found the vertical temperature gradient in unbroken and broken-up sheet clouds to be 0·64 and 0·81 respectively, and also found the average values above and below the stratum. The possible methods of formation of instabilities are discussed, and it is concluded that for clouds of (1) polygonal shape, the shear is zero or very small, (2) rectangular shape, the shear is small and (3) strips, the shear is large. Finally, the application of these results to Ca spectroheliograms of the sun is considered. In the *Discussion,* **C. K. M. Douglas** considered that Helmholtz waves were not extremely rare, and **C. S. Durst** considered that a change of direction as well as of velocity is of importance in the formation of elongated cloud forms, but this latter view was stated by the author to be unnecessary. R. S. R.

1133. General Circulation of the Atmosphere. C. K. M. Douglas. *Roy. Meteorolog. Soc., J.* 57. *pp.* 423–429; *Disc.,* 429–431 *and* 465–468, *Oct.,* 1931.—It is shown that so far as can be judged from present data, there is no appreciable net flow of polar air in the lower troposphere (*i.e.,* between 1 and 4 km.) towards the sub-tropical anticyclone. This supports Jeffrey's view [see Abstract 1531 (1926)] that the exchange of air between different latitudes required to maintain the angular momentum of the zone of west winds against friction is carried out entirely by currents lying side by side, and not one above the other. It is shown that if this exchange of air could be treated by the methods developed in the classical theory of turbulence, cyclones and anticyclones being regarded as eddies in the general circulation, then the supply of angular momentum into the westerly zone would be enormously greater than is required. It is thought that the angular momentum does not diffuse in this way owing to the large size of cyclones and anticyclones, and this is probably to some extent true also of the diffusion of heat and moisture. The fundamental problem is the relation of the individual cyclone to the general circulation, and this has not yet been solved. Some empirical facts are mentioned which may prove useful in future investigations of the subject. **F. J. Whipple,** in a note, shows mathematically that the momentum supplied to the surface air partly overcomes the surface friction and, failing to equal geostrophic speeds, a poleward drift results. At somewhat higher levels an excess momentum is given out and a drift from the pole occurs. The circulation may thus be maintained against friction by large-scale turbulence of the lower atmosphere, the alternation of the cyclone and anticyclone. R. S. R.

1134. Instruments for Sounding the Lower Layers of the Atmosphere. G. Chatterjee. *Gerlands Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 252–263, 1931. *In English.*—The instruments described are: (1) An open-scale Dines meteorograph with a second aneroid and double thermostatic grid, enabling a wider scale to be used, and a device whereby the pen is lifted when the balloon begins to descend and so prevented from blurring the record; (2) a thermograph for recording wet- and dry-bulb temperatures; and (3) a multiple temperature indicator, consisting of a metal comb so constructed that each tooth bends to a different extent at known (different) temperatures, thus making successive electric contacts. Each time a current is thus passed a smoke-producing powder is ignited; the height at which this occurs is observed from the ground by a theodolite. These instruments are designed for use at heights up to about 4 km., and, being cheap, their loss is not serious. C. A. S.

1135. Types of Atmospheric Circulation in the Temperate Zones. F. Baur. *Gerlands Beitr. z. Geophys.* 34 (*Köppen Band,* 3.) *pp.* 264–309, 1931.—The problem is treated mathematically, and it is shown that atmosphere circulation in the temperate zones is predominantly of two types: turbulent interchange, and exchange along north and south band-like tracts. The latter conveys more heat than the former. The conditions for the occurrence of one or the other, and the connection with the sub-tropical belts of high pressure, are discussed, and it is deduced that hot weather should occur on the east side, showery on the west, of a north-south band. The argument is illustrated by charts showing actual pressure distribution at various dates over the northern hemisphere. C. A. S.

1136. Effect of Varying Trade Winds on Gulf Stream Temperatures. C. F. Brooks. *Gerlands Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 400–408, 1931. *In English.*—Previous results are discussed, and it is shown that strong N.E. and S.E. trades in the eastern Atlantic are very likely to be followed respectively 3–6 and 6–9 months later by excess temperatures in the Gulf Stream in the Straits of Florida, and then during the 9th–11th and 10th–12th months by low temperatures. Weak trades give more or less opposite results. These effects seem traceable after appropriate intervals in the weather of the Newfoundland Banks and of N.W. Europe. [See Abstract 3059 (1930).] C. A. S.

1137. Bibliography of Seismology. E. A. Hodgson. *Dominion Observat., Ottawa, Publ.* 10. 11. *pp.* 177–190, *July–Aug.–Sept.*, 1931.

1138. Seismometry and the Earth's History. E. Oddone. *Accad. Lincei, Atti,* 14. *pp.* 192–197, *Sept.*, 1931.—A new discussion of G. H. Darwin's theory of the origin of the moon. The author shows that a period of revolution of four hours, together with a resonance period of two hours, must have made the detachment of a large mass inevitable. Peridotite, with a density 3 to 3·9, was projected first, then basalt of density 2·9, and finally granite, 2·7. These fragments mostly were from the region of the Pacific Ocean. They were gradually assembled into the sphere of the moon by seismic action. E. E. F. d'A.

1139. Maxima in Seismograms from Oceanic Epicentres. E. Rothé. *Gerlands Beitr. z. Geophys.* 34. (*Köppen Band,* 3.) *pp.* 102–122, 1931. *In French.*—Examination of the vertical component seismograms of several Atlantic and Pacific earthquakes shows a peculiar phase ("V" waves) characterised by a large vertical component and velocity (3–3·2 km./sec.), less than that of Rayleigh waves. The "V" waves, and others similar following them, appear to be of the nature of beats, due to interference between trains of waves differing slightly in period and amplitude, such as might be produced by two or three foci ≯ 50 km. apart and sufficiently simultaneous in action to be referred to one earthquake, or by vibrations starting from approximately the same point but travelling with slightly different velocities. Diagrams similar to these seismograms are obtained by the author's apparatus for combining vibrations of different periods and amplitudes. The possibility is discussed of deducing from these results information as to the probable constitution of the earth's crust and distribution of sima and sial. C. A. S.

1140. Experiments in Geophysical Prospecting. D. C. Gall. *Journ. Sci. Instruments,* 8. *pp.* 305–313, *Oct.*, 1931.—To overcome the difficulty of the equipotential line method the author devised a method of plotting two series of lines, (1) equipotential (EP) lines which are almost identical with those of the older method, and (2) equiquadrature (EQ) lines which are 90° out of phase with the EP lines. Both are used with a spacing of known increments of potential and they supplement each other in the indication of anomalies. Diagrams illustrate the apparatus used, the connections and the EP lines around a highly conducting body and of areas with 2, 3 and 5 times the surface conductivity, these being two-dimensional and having no EQ lines. The configuration of the EP and EQ lines is set out for (1) a secondary current at right angles to the main current, (2) a secondary current in the same direction as the main current but displaced in time phase and (3) a highly conducting body, the last two corresponding to a highly conducting body lying respectively in and at right angles to the plane of the current. The method promises to play an important part in the future of electrical prospecting. R. S. R.

1141. Effects Produced by Motion on the Earth's Surface. F. M. Exner. *Gerlands Beitr. z. Geophys. Supplementband,* 1. *pp.* 373–445, 1931. —Under this title is gathered together for posthumous publication Exner's treatment of a number of problems in physical geology. The question of water-flow, dealing with both laminar and turbulent motions and also with cross-sectional velocity and waves, is first considered. The nature of eddies and rolls in air and water is investigated with some application to river beds. The formation of sand-dunes and their migration receives attention, and this leads to a consideration of sand-rippling and of the formation of sandbanks along river courses. Other problems of river features include bank erosion and meandering. In a final section problems of boulder-form and sand-grains have attention. W. A. R.

1142. Tidal Motion in a Flat Rotating Circular Sea Uniformly Shelving from the Centre to the Edge. K. Hidaka. *Imp. Marine Obs., Kobe, Japan. Mem.* 4. *pp.* 285–315, *Nov.*, 1931. *In English.*—For this basin, which is of the form of a shallow circular zone, the law of depth is given by $h = h_0(1 - r/a)$, h being the depth at a distance r from the centre of the sea where the depth is h_0 and a is the radius of the sea measured on its undisturbed surface. Using the continued fraction method the theory for free and forced tides is developed. For free tides the oscillations of both the first and second class, as defined by Hough, are studied. The results are essentially similar to those obtained by Lamb for a paraboloidal sea. The theory was applied to Lake Kuttarausi, Japan, and the results agree tolerably well with observations of seiches. R. S. R.

1143. Heliocentric Path of a Satellite. R. M. Petrie. *Roy. Astron. Soc., Canada, J.* 21. *pp.* 335–342, *Oct.*, 1931.—An expression for the curvature of the heliocentric path of a satellite of a planet is found and a criterion for determining the sign of the maximum curvature is developed. The theory, applied to satellites of planets in the solar system, shows that the moon alone has a path always concave towards the sun. G. C. McV.

1144. Measures of Photochemical Energy during the Total Lunar Eclipse of Sept. 26, 1931. G. Blum. *Comptes Rendus,* 193. *pp.* 647–649, *Oct.* 19, 1931.—Lumière orthochromatic antihalo, 6½ × 9, Aviator plates were used and five exposures taken during totality are compared with 16 exposures out of totality on the same plate; the lunar images are 2·1 mm. in diameter. The exposures of uniform duration of 5 sec. taken at intervals of 4 min., by varying the quantity of light received by a computed amount by means of diaphragms. The results are that the opacity of the crescent image taken during totality by the fourth exposure (diaphragm 40·2 mm.) is sensibly the same as that of the same lunar region taken after eclipse in the first exposure (diaphragm 0·23 mm.). Similarly, for the fifth totality exposure (diaphragm 48·8 mm.) is like that for the same lunar region in the third exposure after eclipse (diaphragm 0·28 mm.). The ratio of photochemical energy is in the first case 30548 and in the second 30377. A. S. D. M.

1145. Photometric Study of the Total Lunar Eclipse of Sept. 26, 1931. R. Gindre. *Comptes Rendus,* 193. *pp.* 714–715, *Oct.* 26, 1931.—The visual stellar magnitude of the moon was compared with that of the planet Saturn, the corrections for atmospheric absorption and for sky brightness being applied. A table of the stellar magnitudes is given for distances of the moon's centre from the centre of the shadow, ranging from − 2·97 m. for 23′ to − 1·42 m. for 13′ 30″. The visual magnitude of Saturn adopted is + 0·83 from comparisons with Vega and Capella. The transparency of the atmosphere was tested repeatedly by observations of Polaris. The author computes the values for this eclipse and compares them with those found by Dufay and Couder for the eclipse of Aug. 14, 1924. The forms of the curves for these two eclipses differ considerably for the same distances from the centre, and the difference is a maximum at the distance 18′, the 1931 eclipse being then 2·5 times as bright as the 1924 eclipse. A. S. D. M.

1146. Photometric and Colorimetric Study of the Total Lunar Eclipse of Sept. 26, 1931. A. Danjon. With a Note by E. Esclangon. *Comptes Rendus,* 193. *pp.* 716–719, *Oct.* 26, 1931.—Danjon observed the eclipse at Cavalaire (Var) in a clear sky, and determined, in function of distance to shadow centre, the diminution of brightness on a photometric screen by means of two colour filters (Wratten 25 and 28). The measures were made throughout the whole phenomenon, for the earliest are necessary for corrections to those made at the centre of the shadow; he expresses the densities of the shadow in stellar magnitudes. A table and diagram are given for the two filters and the two curves present an inflection at 25° distance corresponding to a rapid variation in the difference, V–R, which defines the coloration. He traces the sequence of changing tints. Comparing the eclipses of the last decade, the brightest is that of Oct. 16, 1921; the present eclipse is characterised by the brilliancy of the marginal part of the shadow, the centre part, on the other hand, is a little more sombre. Esclangon points out the value of this observation of the marginal brightness since this depends on the layers high up in the atmosphere which are most subject to important variations, and he links up this observation with the date of the September eclipse so near the equinox, and urges that this form of observation be made when eclipses so occur. On these occasions the atmospheric regions which refract the sun's rays lie along the great circle from pole to pole, so that the lowest atmospheric layers are subject to most various conditions, and opportunity is given for testing how far these lower layers affect the layers much higher up.

A. S. D. M.

1147. Photometric and Actinometric Study of the Total Lunar Eclipse of Sept. 26, 1931. F. Link and J. Devaux. *Comptes Rendus,* 193. *pp.* 998–1000, *Nov.* 23, 1931.—Observations were made at the Pic du Midi (2860 m.), in good seeing (T about 0° and vapour pressure about 1 mm. of mercury). Only the second half of the eclipse was observed. The apparatus is described. The region studied was near Apollonius. Link observed the variation of brightness in terms of distance to the centre of the shadow, using a slit-photometer, and he found a correction of 0·06 and 0·03 (at maximum) from the densities in the blue and red respectively. Devaux used a thermocouple and measured the radiation coming from the moon and from the sky (atmosphere) in the neighbourhood, so as to get the difference in total radiation of energy of the region after traversal of the earth's atmosphere. Measures made with a filter show approximately the lunar secondary radiation of energy, and a table is given. The authors conclude that the photometric measures indicate selection, the density for blue being stronger than for red; that the moon's light in shadow is wholly due to the earth's atmosphere; in the penumbra the difference between red and blue diminishes rapidly and vanishes about 47′ from the centre. The primary radiation in shadow is not measurable, and in the penumbra the solar flux is constant to a first approximation. Devaux cannot find any certain evidence of calorific inertia on the lunar surface, and this inertia must be feeble in the region studied. A. S. D. M.

1148. Motion of Perihelion of Mercury. J. K. Fotheringham. *Roy. Astron. Soc., M.N.* 91. *pp.* 1001–1004, *Oct.,* 1931. *Supplement.*—A note dealing with recent criticisms brought against the reality of the motion of perihelion of mercury. The author concludes that this motion cannot be accounted for on Newtonian grounds in the proposed manner. G. C. McV.

1149. Effective Apparent Wave-Length: Extension of Wien's Law to Receivers of Non-Uniform Sensitiveness. P. Rossier. *Arch. des Sciences,* 13. *pp.* 191–206, *July–Aug.,* 1931.—The law of the displacement of maximum energy with temperature is generalised by considering a law of sensitiveness applicable to the eye and in photography. The wave-length of apparent maximum energy for normal spectra is found between the true maximum and the maximum sensitiveness of the receiver. The problem of receivers with several maxima of sensitiveness (certain photographic plates) is described but not discussed. The general formula for spectra of refraction is also given. Applications to astronomy are discussed: visual and photographic effective wave-lengths; effect of star colour on the index of refraction (0″·2 at 45° altitude); the need for knowledge of the sensitivity distribution of plates used in stellar measurements is emphasised. T. L. M.

1150. Radial Velocity of U Aquilæ. G. Tiercy. *Arch. des Sciences,* 13. *pp.* 237–250, *Sept.–Oct.,* 1931.—The author's indirect method of establishing the light curve from spectra for Cepheids is applied to 11 Arcetri plates; geometrical radii are determined and hence a curve of radial velocities. Full details of the computation are given. The resulting curve is shown to agree satisfactorily with that of Sanford. T. L. M.

1151. Contours of Emission Bands in Novæ and Wolf-Rayet Stars. C. S. Beals. *Roy. Astron. Soc., M.N.* 91. *pp.* 966–977, *Oct.,* 1931. *Supplement.*—Observational evidence in support of the theory that the broad emission bands of Wolf-Rayet stars and Novæ are due to ejection of atoms from the surface of the star due to radiation pressure is given. It is possible, on this theory, to deduce the forms of the band contours on the assumption that (*a*) the radiation of each atom ejected contributes equally to the intensity of the band, (*b*) the distribution of velocities of ejection is given. These theoretical predictions are now verified. The velocities of ejection for one of the Wolf-Rayet stars, found on the basis of the observed contour of the emission band λ4861 and the present theory, range from 400 to 1800 km./sec. G. C. McV.

1152. Plane Grating Spectrograph for Red and Infra-Red Regions of Stellar Spectra. P. W. Merrill. *Mt. Wilson Observat., Contrib. No.* 432. *Astrophys., J.* 74. *pp.* 188–200, *Oct.,* 1931.—In 1924 a grating, of 68 by 70 mm. with 600 lines per mm., by Jacomini, was mounted on a new design by E. C. Nichols. In the yellow and red regions studies have been made on the detached D-lines and bright Hα of Early-Type Stars (a plate is given); on extra strong calcium lines in K- and M-types; and on radial-velocity of N-type. In the infra-red, λ8700 is reached. Of especial interest is the forbidden nebular line 7325 (a multiplet) which has been identified with OII. A. S. D. M.

1153. Spectra of B Stars. O. Struve. *Astrophys. J.* 74. *pp.* 225–267, *Nov.,* 1931.—Spectrograms of 13 stars ranging in spectral type from O9 to B8 were measured in order to obtain a reasonably complete list of absorption lines in the hottest stars, and the table of wave-lengths here given contains 379 lines, of which about 150 are new and about 130 have been newly identified. The contours of the HeI lines were investigated, and members of two series are found to be highly susceptible to Stark effect, as are also members of the Fowler series of HeII. Intensities of several pairs of lines of HeI were estimated, and it appears that the ratio of intensity singlet/triplet is greatest for stars of type B2, and decreases rapidly towards O and slowly towards B9. This is not due to temperature-ionisation, nor to effects of pressure or electrical fields, but possibly to a change of atomic absorption coefficient depending on outside conditions, or to a departure from thermodynamic equilibrium. Several lines of NII and OII which are diffuse in the laboratory are not broadened in stars. Members of doublets and quartets in OII have approximately the same relative intensities in stars as in the laboratory. Lines of silicon belonging to two stages of ionisation are simultaneously strengthened in giants, which cannot be explained by the earlier form of ionisation theory, but is probably a consequence of Milne's "null-effect." The upper value of possible deviation in abundance of silicon in individual stars does not exceed 5 : 1, and probably is below 2 : 1. M. A. E.

1154. Photoelectric Colours of Stars of Early Type. C. T. Elvey. *Astrophys. J.* 74. *pp.* 298–311, *Dec.*, 1931.—The colours of 153 early stars have been determined photoelectrically using dense filters transmitting round 5100 Å. and 3850 Å. respectively. There is fairly good correlation with Bottlinger's results, the scale, however, being quite different owing mainly to the choice of filters. The stars with most red excess for their type are nearly all close to the galactic plane. There is correlation of reddening with apparent magnitude, indicating absorption in interstellar space; when this is allowed for there is also correlation of reddening with total absorption by H_β and H_γ, indicating an effect in the star's own atmosphere; this is probably absorption by the overlapping wings of violet hydrogen lines [see Abstract 2208 (1931)]. It is concluded that both causes of reddening are real. R. d'E. A.

1155. Distribution of Absolute Magnitudes among A and B Stars from Parallactic Motions. G. Strömberg. *Mt. Wilson Observat. Contrib., No.* 440. *Astrophys. J.* 74. *pp.* 342–358, *Dec.*, 1931.—A continuation of previous work on the later types [see Abstract 373 (1932)]; in this case, however, only parallactic motions could be used. In all stellar classes investigated two or more maxima of the distribution function are again found. It is pointed out that some of these are based on somewhat small numbers of stars and that the results may also be affected by the tendency of B stars to form moving groups; on the other hand, the maxima run fairly continuously from one spectral class to another. In particular, there seems to be a branch fainter than the main sequence in the earliest classes, and it is accordingly suggested that the line of the "normal giants" crosses the main sequence at about the A stars. A summary and discussion for the types B0 to M are promised. R. d'E. A.

1156. Space Distribution of Boss Stars. R. D. H. Jones. *Roy. Astron. Soc., M.N.* 91. *pp.* 990–1001, *Oct.*, 1931. *Supplement.*—The stars included in Boss' Preliminary General Catalogue are examined as to space distribution with a view to verifying the law of density $D(r) = Ae^{-k^2r^2}/r$. Two methods are used for comparing observed and theoretical proper motion statistics: (1) the form of the drift curves in any region for stars whose proper motions exceeded 2″, 3″, etc., per century; (2) the distribution of magnitudes of proper motions, irrespective of position angle, in any region. Both methods give results agreeing with the above law of density, although they do not give exactly the same value of the constant k.

G. C. McV.

1157. Numerical Method of Determining the Space Density of Stars. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 436. *Astrophys. J.* 74. *pp.* 268–287, *Nov.,* 1931.—The article develops and illustrates a numerical method of solving by approximations the fundamental integral equation of stellar statistics for the determination of the space-density function. The unknowns are the relative densities d in successive spherical shells whose thickness corresponds to a constant increment in the logarithm of the distance. The first approximation is obtained by using the fact that the star ratio for magnitudes $m + 1$ and m, which is known from star counts, bears a simple relation to the weighted mean d for the shells which contribute stars of magnitude m. The final approximation is made by calculating the effect of changing each d in succession by a standard amount, and then combining the series of differential changes, each multiplied by an appropriate factor, in such a way as to reproduce the residuals left by the preceding approximation. No assumption is made as to the form of the density function or the frequency functions for apparent and absolute magnitudes. The luminosity function may vary with the distance. The illustrative example, solved with a luminosity function which is the same at all distances, leads to a rapid change in density close to the sun that is not supported by other evidence. The discordance is discussed in Contribution No. 437 [see following Abstract]. AUTHOR.

1158. Variation in the Luminosity Function with Distance from the Sun. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 437. *Astrophys. J.* 74. *pp.* 312–319, *Dec.,* 1931.—The rapidly changing space density of stars found for points near the sun denotes an error either in the star counts used for the calculation or in the assumed constancy of the luminosity function. Error in the counts would imply an inadmissible error in the magnitude scale; the alternative to be accepted is a decrease in the frequencies of high-luminosity stars with increasing distance from the sun. Evidence from van Rhijn's discussion of the luminosity function confirms the dependence on distance and suggests a change with galactic latitude. These conclusions are in harmony with the structure of the local system. The thin stratum of helium stars concentrated in this system, and possibly part of the A stars, accounts qualitatively at least for the excess of high luminosities near the sun. Elsewhere the mean density of these stars is low; hence, the frequencies for $M < 0$ decrease with increasing distance. The exaggerated distance effect occurring in high galactic latitudes because of the thinness of the stratum of helium stars introduces a dependence of frequency on latitude for stars situated at the same distance from the sun. Allowance for the variation in the frequencies will flatten the curve of space density found with a constant luminosity function, decreasing densities within 200 parsecs of the sun and increasing those at greater distances. AUTHOR.

1159. Mean Parallaxes and the Luminosity Function. F. H. Seares. *Mt. Wilson Observat., Contrib. No.* 438. *Astrophys. J.* 74. *pp.* 320–327, *Dec.,* 1931.—Mean parallaxes of faint stars obtained by van Maanen and Willis are used to extend and correct a formula connecting mean parallax, proper motion and apparent magnitude. A constant linear velocity for all magnitudes was assumed in obtaining the mean parallaxes, and since these exhibit differences from the formula that correlate with absolute magnitude the results provide additional evidence of a real correlation of linear velocity and absolute magnitude. The Gaussian form of the luminosity function is again shown to be an unjustified extrapolation, the function increasing at least as far as absolute magnitude 14. R. d'E. A.

1160. Effect of Opacity in Point-Source Stellar Model. J. C. P. Miller. *Roy. Astron. Soc., M.N.* 91. *pp.* 984–989, *Oct.*, 1931. *Supplement.*—A point-source model of perfect gas with the law of opacity $k = k_1\rho/T^{7/2}$ is studied with the object of determining what the value of k_1 must be so that the density does not begin to decrease as we go inwards until a temperature of $10^{9\circ}$ C. is reached. The value of k_1 is only some ten times greater than that found by Eddington in a model with the same mass and boundary condition, but in which the stationary point in the density occurred at a temperature of $10^{6\circ}$ C. G. C. McV.

1161. Opacity of Stellar Material. E. A. Milne. *Zeits. f. Astrophysik*, 3. 4. *pp.* 253–260, *Oct.*, 1931.—In any arbitrary stellar model it is possible to assign an indefinitely small value to the opacity in the central regions provided the energy-sources are supposed sufficiently concentrated towards the centre. In particular the opacity demanded by physical theory may thus be attained. Thus it is not possible to infer an astronomical value for the opacity as long as there is no definite knowledge of the distribution of energy-sources, *i.e.*, no actual theory of energy-generation. There is therefore no conflict between physics and astronomy on the question of opacity. R. d'E. A.

1162. Dark Nebula near θ Ophiuchi. R. Müller. *Zeits. f. Astrophysik*, 3. 4. *pp.* 261–269, *Oct.* 24, 1931.—Star counts in the dark nebula near θ Ophiuchi indicate the existence of two absorbing clouds. In the darkest part of the field, where the stars are all of apparent magnitude 11 or fainter, the absence of brighter stars is accounted for by the combination of a foreground cloud at about 100 parsecs and a second more extensive cloud at about 250 parsecs distance. The absorption reaches the amount of four magnitudes. The region near θ Ophiuchi has appreciably fewer stars than the gaps in the Milky Way that have previously been examined, and fewer even than the neighbourhood of the galactic pole. R. d'E. A.

1163. Dynamics of Star Systems. K. Pilowski. *Zeits. f. Astrophysik*, 3. 4. *pp.* 279–290, *Oct.* 24, 1931.—The investigations made in a previous paper [see Abstract 62 (1932)] on the influence of a secular decrease of mass on the dynamics of the normally moving star systems are extended to the case of the more rapidly moving groups. Explanations of the asymmetry curve and of the dependence of the vertex on the mean velocity of the star groups are obtained. J. E. K.

1164. Mean K-Effect and Galactic Rotation. K. Pilowski. *Zeits. f. Astrophysik*, 3. 4. *pp.* 291–301, *Oct.* 24, 1931.—An explanation of the mean K-effect is obtained without the aid of a restricting assumption introduced in a previous paper [see Abstract 62 (1932)]. The existence of a differential rotation dependent on z (the distance from the plane of the Milky Way) is proved from the proper motions in the galactic breadth and its amount is calculated. J. E. K.

1165. Moving Clusters. M. Kaburaki. *Imp. Acad. Tokyo. Proc.* 7. *pp.* 294–297, *Oct.*, 1931.—There are four moving clusters which have low space-velocities (about 6 km./sec.) of which two, Perseus and Scorpio-Centaurus, are widely spread in galactic longitude and in distance (from 50 to 120 parsecs), and two, Pleiades and Orion, are compact with but few stars. The author considers the effect of galactic rotation on the first two, both on their radial velocities and on their proper motions; these he summarises in a table, and finds that the results based on the radial velocities nearly coincide with those upon the proper motions. He concludes that the moving clusters with low velocities, such as the Perseus and Scorpio-Centaurus, and also the Pleiades, appear to partake of the galactic rotation rather than of the motion proper to moving clusters in general. In the Orion Cluster, the observed radial velocity agrees with the computed, but the observed proper motion differs considerably from the computed, and this last may be due either to the occurrence of some other motion in this cluster, or to the uncertainty of the distances and proper motions. The other three clusters appear not to have the characteristic property of moving in space in parallel directions and with the same speed. A. S. D. M.

1166. Relative Abundance of Chemical Elements in White Dwarfs. S. Suzuki. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 307–310, *Oct., and p.* 395, *Dec.*, 1931. *In English.* From Milne's formula for the concentration of a degenerate gas it is shown that the interior of a white dwarf may consist of heavy radioactive elements. G. C. McV.

1167. White Dwarf O_2 Eridani B. S. C. Sekhar. *Zeits. f. Astrophysik*, 3. 4. *pp.* 302–305, *Oct.* 24, 1931. *In English.*—Using a previous calculation of the opacity of a non-relativisitic highly degenerate mass of gas obeying the Fermi–Dirac statistics, the author obtains values for the central temperature and density and the mean molecular weight of O_2 Eridani B. It is assumed that the mean constitution is roughly that of iron and that the energy-sources are somewhat concentrated towards the centre. The results are in agreement with the view that the star approximates closely to an Emden polytrope of index 3/2. The central temperature is obtained as 94 million degrees and the mean molecular weight as $2 \cdot 023\ m_H$. R. d'E. A.

1168. Central Temperatures of Main Sequence Stars. L. Biermann. *Zeits. f. Astrophysik*, 3. 4. *pp.* 306–312, *Oct.*, 1931.—A selection of numerical integrations, of extreme and typical cases, allows a general conclusion as to the way the central temperatures of main sequence stars will vary along the sequence for different laws of energy-generation. The Kramers formula for the absorption coefficient is used throughout, and the mean molecular weight is taken as 2·2 [see Abstract 67 (1932)]. With energy-generation per gm. proportional to the temperature the central temperatures are nearly independent of the masses; with a more rapid dependence of ϵ on temperature the central temperatures decrease with increasing masses. Since the densities certainly decrease, and the mean energy-generation certainly increases, with increasing mass, it follows that $(\partial\epsilon/\partial\rho) \,.\, (\partial\epsilon/\partial T)$ must be negative. It is shown that the conclusion is practically unaltered in a pure hydrogen star. Atkinson's theory of energy-generation [see Abstract 4153 (1931)] cannot be reconciled with these calculations. R. d'E. A.

1169. Chemical Reactions at High Temperatures and Composition of Stellar Atmospheres. G. Piccardi. *Accad. d'Italia, Mem.* 2. 7. (*Chim.*), [54 *pp.*], 1931.—A spectroscopic study has been made of the reactions between H_2O with magnesium, aluminium, zinc and cadmium in homogeneous gases at very high temperatures, and it appears that in these conditions the reactions lead through a complex series of states of equilibrium to a simultaneous formation of oxides and hydrides. These results are applied to sunspots, in which several oxides and hydrides exist, and a research is described which makes it probable that the molecule H_2 also exists there. In studying the atmospheres of red stars the research should not be founded on physical laws only, but also on chemical and chemico-physical laws. M. A. E.

1170. Constitution of Stars. H. N. Russell. *Roy. Astron. Soc., M.N.* 91. *pp.* 951–966, *Oct.*, 1931. *Supplement.*—A general discussion of the theory of stellar structure to date dealing especially with the bearing of the theory of homologous stars on Milne's latest models. It is shown why a complete deductive theory of stellar constitution is impossible at present and it is contended that Milne's "standard" model involves assumptions with regard to the rate of energy generation, opacity and molecular weight which are contrary to fact. The general theory of homologous stars leads to the conclusion that, if a star of given mass is to have an assigned luminosity within given limits, then stars must differ in composition. It is shown that this is implied in the structure of Milne's models. Further, the mass-luminosity law for homologous stars is found to be very insensitive for considerable changes in the model. The relation of luminosity and effective temperature is a much more searching test. Observationally, this latter test compels us to believe that actual stars do differ in composition. The author concludes that until the problem of energy-generation is solved theories of stellar structure must remain very speculative. G. C. McV.

1171. Dynamical Parallaxes of Double Stars. D. Barbier. *Comptes Rendus*, 193. *pp.* 709–711, *Oct.* 26, 1931.—The author deals with the general errors attendant on the fact that the dynamical parallax of a double star is derived from an orbit that is not completely determined. The treatment is mathematical throughout, and it is found that $p(j, \phi)$ and $P(e, g)$ (where j is the angle between the true radius vector and its projection, ϕ is the angle between the plane normal to the radius vector and the orbital plane, e is the eccentricity and g the mean anomaly) are not as independent as was supposed, nor is it correct to take $P(eg)dedg$ as in the form $P_1(e)dedg$ either when the orbit is known or is unknown. He gives tests from the dynamical parallaxes found by Jackson for the Greenwich Double Star Catalogue and by Russell and Hertzsprung from Schlesinger's General Catalogue of Stellar parallaxes. A. S. D. M.

1172. Separation of the Poles of the Orbits of Double Stars. D. Barbier. *Comptes Rendus*, 193. *pp.* 839–841, *Nov.* 9, 1931.—Numerous previous researches have led to uncertain and contradictory results. The author used 74 stars from Russell's list for which $\cot V > 8$, where V is the angle between the tangent to the projection of the trajectory and the projection of the radius vector. From probability considerations the range of latitude and longitude is found for the poles and the region of concentration lies around $\lambda = -30°$ and $\beta = 0$, where λ and β are the galactic coordinates. This point is very near to the direction of the centre of the galaxy having coordinates $\lambda = 325°$ and $\beta = 0$. R. S. R.

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1173. Selective Absorption. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 91. *pp.* 977–984, *Oct.*, 1931. *Supplement.*—The theory of the broadening of absorption lines in the spectrum is given on the basis of quantum mechanics. The energy levels in an atom are treated as consisting of small ranges of frequency so that transitions are possible between two given levels resulting in the emission of quanta of slightly different frequencies. The probabilities of the transitions are worked out. G. C. McV.

1174. Relative Spectral Energy Distribution and Correlated Colour Temperature of the N.P.L. White-Light Standard. R. Davis and K. S. Gibson. *Bureau of Standards, J. of Research,* 7. *pp.* 791–797, *Nov.*, 1931.—The spectral characteristics of the two Guild–Young filters have been deduced from their specifications. The first of these filters, in conjunction with a source having the relative spectral energy distribution given by Planck's formula for a temperature of 2360° K., is used to calibrate a gasfilled lamp. This lamp is used in turn with the second filter to produce the N.P.L. standard white light. Computations indicate that the chromaticity of the first source-and-filter combination approximates closely to that of a Planckian radiator at 2931° K. Using as a source the relative spectral energy distribution corresponding to 2931° K. in combination with the second filter the authors have obtained the spectral energy distribution and the chromaticity of the N.P.L. white-light standard. This latter turns out to be approximately that of a Planckian radiator at 4831° K. Comparison is made with the Davis–Gibson source-filter combination for obtaining a colour temperature of 4800° K. AUTHORS.

1175. General Formula for Colorimetric Purity. D. B. Judd. *Bureau of Standards, J. of Research,* 7. *pp.* 827–841, *Nov.*, 1931. *J.O.S.A.* 21. *pp.* 729–747, *Nov.*, 1931.—The formula for purity is called general because if the trilinear coordinates of any colour referred to any given set of primary colour processes and any basic stimulus be given, the colorimetric purity of this stimulus may be computed with respect to any heterogeneous stimulus as the fixed stimulus of homo-heterogeneous analysis. The derivation of the formula is given and five special cases of historical and practical interest are worked out in order to demonstrate that previous formulæ for the computation of colorimetric purity and an allied ratio are special cases of this one. The connection is also given between colorimetric purity and the allied ratio variously known as saturation, saturation fraction and *Sättigung.* AUTHOR.

1176. Size of Object and Speed of Vision. C. E. Ferree and G Rand. *Am. Illum. Eng. Soc., Trans.* 26. *pp.* 820–856, *Oct.*, 1931.—Describes experiments on the rate of perception of a broken circle test-object of different sizes when viewed under different illuminations. The sizes used ranged from 1 to 5·2′ of arc and the illuminations from 1·25 to 100 foot-candles. The background had reflection factors ranging from 4 to 78 %. A large number of curves are given in the paper to show the effect of these various factors on the speed of vision. J. W. T. W.

1177. Colour Confusion by Daltonians. Polack. *Comptes Rendus*, 193. *pp.* 878–880, *Nov.* 9, 1931.—By Seebeck's method it is found that Daltonians confuse blue, violet, purple and blue-green even when saturated. To facilitate the examination of the colour sensation, the author has devised a test of an assortment of colours of various intensities and divided them into two groups, the first containing the colours mentioned above. The first group is used for a quick diagnosis and second group is added for more accurate tests. It is suggested that Daltonism should be subjected to the various colour-vision theories. H. M. B.

1178. Reflection of Light by the Concave Rectangular Dihedron and Trihedron. L. Dunoyer. *Rev. d'Optique*, 10. *pp.* 437–452, *Nov.*, 1931.—A general method for the determination of the shape and dimensions of the beam reflected from the reflecting systems of optical instruments is developed, and is applied to the cases of the concave rectangular dihedron and trihedron, which are commonly used in signalling. In the correct orientation these systems return the incident beam parallel to its original direction after reflection at each face. In particular, it is shown that the flux reflected by the trihedron depends only on the angle between the incident beam and the axis of the system, provided that this is less than $\cos^{-1}\frac{2\sqrt{2}}{3}$. At greater inclinations, the flux depends on the orientation of the trihedron. The system can never reflect more than $\frac{2}{3}$ of the incident flux. C. B. A.

1179. Reflection Characteristics of Paints. P. Kubelka and F. Munk. *Zeits. f. techn. Physik*, 12. 11*a*. *pp.* 593–601, 1931.—A theoretical treatment of the subject of covering power of a paint. The characteristics of the paint are s, the absorption factor, and r the reflection factor. The authors develop formulæ for the brightness of a surface composed of any given thickness of a neutral (uncoloured) material having these characteristics, (*a*) when the ground material is white, and (*b*) in terms of the brightness of an infinitely thick layer of the same material. The use of a "kryptometer" of the Pfund type for measuring the covering power of a pigment is examined. It is pointed out that, although the treatment in the paper deals only with neutral materials, the results can be extended to coloured materials by applying them to each part of the spectrum separately. **Errata,** *ibid.*, 13. 2. p. 101, 1932. J. W. T. W.

1180. Refraction and Reflection in General Relativity. H. S. Ruse. *Pont. Accad. Sci., N. Lincei, Atti*, 84. *pp.* 662–672, 1930–1931. *In English.*—Extends the work of Levi-Civita from optically isotropic to anisotropic media [see Abstract 3769 (1931)]. E. E. F. d'A.

1181. Temperature of Maximum Refractivity of Aqueous Solutions. N. Gregg-Wilson and R. Wright. *J. Phys. Chem.* 35. *pp.* 3011–3014, *Oct.*, 1931.—The temperature of maximum refractivity of water and of some aqueous solutions is determined with a dipping refractometer. The value found for water is about − 0·5° C., while for solutions it falls with increase of concentration. C. B. A.

1182. Optical Rotatory Powers of d-β-Octyl Hydrogen Phthalate and its Derivatives. H. G. Rule and J. M. Hill. *Chem. Soc., J.*, *pp.* 2644–2658, *Oct.*, 1931.—The rotatory powers of *d*-β-octyl hydrogen phthalate and its alkali salts vary considerably with concentration. Salt formation lowers the rotation of the acid, the effects decreasing in the order Rb to Li. Addition of electrolytes produces a marked depression in the rotatory power of the sodium salt, bivalent kations producing greater effects than univalent kations, the orders of effectiveness again being Rb to Li, and Ba to Mg. These variations are identical with those observed for *l*-malic acid, and it is concluded that the sensitivity of malic and tartaric acids towards neutral electrolytes and change of concentration is not necessarily related to the presence of alcoholic hydroxyl groups, but may be due to the carboxylic group. In solvents derived from benzene the rotations of *d*-*β*-octyl hydrogen phthalate and of its methyl ester vary with the polarity of the medium, high polarity producing low rotation. The effect of aliphatic solvents is irregular. Screening of the dipole by the alkyl group is observed. *m*- and *p*-disubstituted benzenes produce considerable depressions, despite the zero moments of the latter. The depressions in the rotatory power of sodium octyl phthalate caused by electrolytes may be compared to those produced in the acid by polar solvents. A similar relationship exists in the case of tartaric acid. C. B. A.

1183. Relation between Double Refraction and Crystal Structure. W. A. Wooster. *Zeits. f. Krist.* 80. 5–6. *pp.* 495–503, *Nov.*, 1931. *In English.*—Seventy-seven inorganic substances for which sufficient data are available are classified into 6 groups, each of similar optical character, to which certain structural types to at least some degree correspond: (1) all layer lattices not containing a hydroxyl group are optically negative, and the presence of such a group tends to make the sign more positive, *e.g.*, $Cd(OH)_2$ compared with CdI_2; (2) chain lattices with the chains parallel to the optic axis are positive; (3) strongly asymmetric groups doubly refract so that the electric vector of the more refracted ray is parallel to the shortest bonds; (4) all symmetrical groups, and (5) all three dimensional lattices consisting of symmetrical groups exhibit low birefringence; (6) certain iron and titanium compounds, *e.g.*, hæmatite, titanite, rutile, etc., show very high birefringence irrespective of structure. C. A. S.

1184. Double Refraction by Compression in Amorphous Silica and Crystalline Quartz, and its Dispersion in the Ultra-Violet. G. Bruhat and J. Thouvenin. *Comptes Rendus*, 193. *pp.* 843–845, *Nov.* 9, 1931. *J. de Physique et le Radium*, 3. *pp.* 1–30, *Jan.*, 1932.—The compensator previously described [see Abstract 799 (1932)] is used to measure the birefringence produced by compression in silica and quartz. For silica, the birefringence for a given wave-length is found to be proportional to the pressure to within 1 %. In all the plates studied, either silica or quartz, the vibration parallel to the direction of compression is the faster. In order to neutralise the effect of the rotatory power, the quartz plates consist of equal sections of right- and left-handed crystals cut perpendicularly to the axis. The double refraction produced in silica is 40 % greater than that in crystalline quartz. The Havelock formula for the variation of double refraction with refractive index is shown to be only approximately correct, although it gives the correct order of magnitude and the correct sign. C. B. A.

1185. Examination of Large Quartz Crystals by Immersion. A. Arnulf. *Rev. d'Optique*, 10. *pp.* 453–473, *Nov.*, 1931.—The method is suitable for gross specimens, and for exposing faults, inclusions, threads, etc., in the interior of quartz crystals. It is also possible to derive some optical data, such as rotatory power. The crystal is immersed in a liquid of refractive index equal to that of the ordinary ray, and viewed against a dark background with suitable illumination. A convenient stereoscopic arrangement is described. F. I. G. R.

1186. Magnetic Birefringence of Paramagnetic Salts in Aqueous Solution. C. Haenny. *Comptes Rendus,* 193. *pp.* 931–932, *Nov.* 16, 1931.—Solutions of cerous nitrate, examined with the apparatus of Cotton and Dupouy [see Abstract 2795 (1930)], show very high negative magnetic birefringence, which is much higher than that of CS_2 and comparable with that obtained for aromatic liquids. The birefringence is not proportional to the concentration of cerium. The dispersion is of the same order as that of nitrobenzene and other organic compounds. Under the same conditions, the double nitrate of neodymium and magnesium gives an effect so small as to be hardly separable from that due to the water. A concentrated solution of gadolinium nitrate also gives very feeble birefringence. C. B. A.

1187. Magneto-Rotatory Dispersion in the Ultra-Violet. E. Miescher. *Helv. Phys. Acta,* 4. 6. *pp.* 398–408, 1931. *In German.*—The Hagenbach polarimeter [see Abstract 3387 (1930)] is modified for measurement of the magneto-rotatory dispersions of water and hexane in the ultra-violet. Verdet's constants are given for water for 22 wave-lengths between 5461 Å. and 2482 Å. $(\omega^{20^\circ}_{5461} = 0\cdot0155$ min. per cm.-gauss$)$, and for hexane for 9 wave-lengths between 5893 Å. and 2655 Å. $(\omega^{20^\circ}_{5461} = 0\cdot0141$ min. per cm.-gauss$)$. The values for water agree with those of Richardson, but diverge slightly from those given by Roberts and by Landau; the values for hexane are in good agreement with the ratios found by Lowry and Dickson. C. B. A.

1188. Decrease in Visible and Infra-Red Radiation Produced by Artificial Mists and Their Effect on Visibility. W. Külb. *Ann. d. Physik,* 11. 6. *pp.* 679–726, *Nov.* 10, 1931.—Experiments are described for the determination of the influence of artificial mists on radiations of wave-length $0\cdot4\,\mu$ to $4\cdot0\,\mu$. The radiation intensity is decreased partly by absorption and partly on account of scattering by the droplets, the effect of their size being considered. In general, for increase in wave-length of light, the lessening of the radiation due to mist decreases. The chief experimental difficulty in the infra-red is to find a suitable receiver. Theory and experiment are compared. The appearance of self-luminous bodies and bodies illuminated by diffuse or direct light is considered from a theoretical standpoint. As the artificial mists are essentially water-vapour with various condensation nuclei, very similar results should be obtained with natural mists. H. M. B.

1189. Extra-Axial Fringes. F. Scandone. *N. Cimento,* 8. *pp.* 310–319, *Aug.–Sept.–Oct.,* 1931.—Generalises previous results [see Abstract 3421 (1931)] in which were considered the traits of a parallel network at right angles to the plane of symmetry. The characteristic phenomena of the "rotation" of the anastigmatic fringes are considered, and very simple relations are deduced between the characteristic elements of the fringes and the coefficients of the astigmatism and of the coma. A. D.

1190. "Tavistock" Transit Theodolite. E. W. Taylor. *Optical Soc., Trans.* 32. 2. *pp.* 45–57; *Disc.,* 57–60, 1930–1931.—A conference of surveyors was held at Tavistock in 1926 and a specification for a service pattern theodolite was there drawn up. The "Tavistock" theodolite, a description of which follows, was designed to this specification and incorporates a novel method of reading the circles. AUTHOR.

1191. Modern Optical Glass. T. Smith. *Optical Soc., Trans.* 32. 3. *pp.* 85–98; *Disc.*, 98–100, 1930–1931.—The optical positions (μ, ν) of the glass types catalogued by the Parsons Optical Glass Company, and the relations between the dispersions for several segments of the visible spectrum, are exhibited graphically. It is shown that a knowledge of the refractive indices of any glass for three wave-lengths is sufficient to specify the index for the whole of the visible spectrum, and a knowledge of two indices is almost sufficient. In particular the partial dispersive ratios are almost functions (nearly linear functions) of ν only. This implies that there are no glasses suitable for making apochromatic telescope objectives of large relative aperture. The graphs show that the general standard of accuracy of the measured indices is high. A new graphical method of interpolating refractive indices for glass is obtained. AUTHOR.

1192. Fused Bifocal Spectacle Lenses. A. Whitwell. *Optical Soc., Trans.* 32. 3. *pp.* 101–111; *Disc.*, 112, 1930–1931.—In designing a fused bifocal spectacle lens three radii can be varied to satisfy the two conditions, that the distance power and the reading addition have given values, so leaving one degree of freedom. An expression is found for the convergence of the circles of least confusion of oblique pencils of small aperture; from this, by equating the aberration term to zero, a quadratic equation is obtained, the roots of which fix the radius of one surface of the lens subject to the third condition that the circles of least confusion lie on a sphere and so focus on the macula of the eye. AUTHOR.

1193. Optical Registering Apparatus. J. Picht. *Zeits. f. Instrumentenk.* 51. *pp.* 574–578, *Nov.*, 1931.—The author describes the usual optical arrangements and views which have been expressed regarding the vertical and horizontal extension of the image. Numerical considerations regarding the height and breadth of the image for various distances of the photographic paper from the focussing lens and different arrangements of lenses are given. Finally the arrangement of lenses is described which will give the smallest and brightest point image and also time marks. R. S. R.

1194. New Mirror Spectrometer (Monochromator) with Single and Double Dispersion for the Range 0·2 to 4 μ. C. Leiss. *Zeits. f. Physik*, 72. 11–12. *pp.* 822–828, *Nov.* 16, 1931.—This is of the same type as the Rubens instrument, using mirrors instead of lenses, but adapted for use in the ultra-violet by using mirrors due to Hochheim. These have a high reflecting power in the spectral region concerned. J. H. A.

1195. Testing of Coma and Errors of Colour Magnification with Photographic Objectives. A. Wetthauer. *Zeits. f. Instrumentenk.* 51. *pp.* 553–559, *Nov.*, 1931. *From the Reichsanstalt.*—To obtain the chromatic and spherical aberration for photographic objectives it is sufficient to obtain the position of the image surface, but where powerful illumination is used, as for kino-objectives, these aberrations are required for oblique transmission. An arrangement is described in which a special type of zonal slit is used with different opening ratios and the axial displacement of the image is recorded on a photographic plate. The slit is at the focal plane of the collimator, and the objective tested and the photographic plate rotate together for various inclinations to the axis. The longitudinal and transverse aberrations, and thence the coma, are obtained. Chromatic aberration is obtained by a process similar to that for the meridional coma. R. S. R.

1196. New Lustre-Meter and Spectrophotometer. H. Boffey and D. A. Derrett-Smith. *Journ. Sci. Instruments*, 8. *pp.* 356–360, *Nov.*, 1931.—A description is given of a new instrument for measuring the lustre or gloss of a surface. Useful features of this instrument are: (1) that angles of incidence and reflection of the light can be varied over a wide range, thus allowing of very complete lustre curves being obtained; (2) the test sample need not be cut for measurement; (3) easy portability. Typical lustre curves are shown for a variety of surfaces and some of the results are briefly discussed. The instrument can also be used as a spectrophotometer. AUTHORS.

1197. Recording Microphotometer of High Precision. D. Chalonge and P. Lambert. *Rev. d'Optique*, 10. *pp.* 405–413, *Oct.*, 1931.—Describes an improved form of photoelectric recording microphotometer, with special reference to its use for obtaining density curves of photographs of spectra. The photo-cell is of the thick-film cæsium type in vacuum. The current is amplified 1000 to 2000 times and passes through an aperiodic galvanometer. Examples of the records obtained, particularly when the spectra are rich in lines, are given in the paper. The instrument can be used to study the fine structure of lines and the intensity of the continuous spectrum which forms a background to the line spectrum in many cases. J. W. T. W.

1198. Photoelectric Photometer of the Yerkes Observatory. J. Stebbins. *Astrophys. J.* 74. *pp.* 289–297, *Dec.*, 1931.—A description of a photoelectric stellar photometer designed for use with the 40-in. refractor is given. Among the innovations are a double-slide motion of the photometer for quick setting, a finder with a large field, motor-driven sectors for equalising the light of stars, filters for measurement of colour indices and a Lindemann electrometer. The photoelectric cell by Kunz is potassium hydride in a quartz tube. The sensitivity of the installation is such that stars as faint as the ninth magnitude can be measured, and the limit of detection in current is about 10^{-15} ampere. The instrument is being used principally for the determination of colours of B-stars which are also under spectroscopic observation at the Yerkes Observatory. AUTHOR.

1199. Flicker Photometer of the Diffusing Block Type. L. Piatti. *Zeits. f. Physik*, 72. 11–12. *pp.* 803–810, *Nov.* 16, 1931.—Describes a form of Joly block photometer in which the illumination of the two sides of the block is rapidly alternated. The principle and the mechanical details of the instrument are fully described in the paper. No provision is made for enabling the Ives conditions for the use of a flicker photometer to be observed. The author estimates the accuracy as 1 % with no colour difference and 2 % under other conditions. J. W. T. W.

1200. Conception of Brightness. J. Dourgnon. *R.G.E.* 30. *pp.* 747–751, *Nov.* 7, 1931.—The author considers the use of the notion of brightness

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as the fundamental idea in photometric work. Brightness is defined as luminous intensity per unit area, or as flux per unit area per unit solid angle in a given direction. It is independent of distance, *i.e.*, the brightness of a surface at a point M in any given direction *xx'* is independent of the position of M along this line *xx'*. It is proportional, however, to the square of the index of refraction of the medium in which M is situated.
J. W. T. W.

1201. Silver-Ion–Gelatin Equilibrium in Photographic Emulsions. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research,* 7. *pp.* 811–825, *Nov.,* 1931.—Electrometric determination of silver ion activity in silver nitrate–gelatin solutions showed strong selective combination of silver ion with gelatin. This decreases with increasing hydrogen-ion concentration, but does not vanish on the acid side of the isoelectric point. Similar measurements in silver bromide–ammonia–gelatin solutions detected no combination of gelatin with the silver-ammonia ion. The hydrolysis of silver bromide and chloride in thoroughly washed emulsions was calculated from the electrometric data and verified by direct experiment. AUTHORS.

1202. Variation of Photographic Sensitivity with Different Light Sources. R. Davis and G. K. Neeland. *Bureau of Standards, J. of Research,* 7. *pp.* 843–850, *Nov.,* 1931.—The variation of photographic sensitivity (as measured by the index $10/E_m$) with different light sources of equal visual intensity, but having different distributions of energy, was experimentally obtained. Ordinary, orthochromatic and three new fast panchromatic plates were investigated. Distinction was made between two types of sensitivity comparisons. Thus it was found that, first, the ratio of the sensitivity of any one of the panchromatic plates to that of the ordinary plate was greater with " incandescent " lighting than when " sunlight " was used, and, second, in all cases the panchromatic plates were less sensitive to " incandescent " lighting than to " sunlight." Approximate factors are included (for the particular emulsions studied) by which visual exposure meter readings should be multiplied when certain types of illuminants are encountered. AUTHORS.

1203. Increase of Sensitivity of Plates for the Infra-Red by Warming. O. Bartelt. *Zeits. f. wiss. Phot.* 30. 9. *pp.* 261–271, *Nov.,* 1931.—The influence of the alcohol and ammonia contents and temperature of the bath on the degree of sensitisation of a certain type of plate by allocyanin to the wave-lengths between 9500 Å. and 10,800 Å. has been determined. The sensitivity of the plates falls only slowly after drying. For plates sensitised under standard conditions the sensitivity rises with increase of temperature to a maximum at 87° C., and at higher temperatures diminishes; in all cases the sensitivity decreases with increase of wave-length. For various plates treated with neocyanin and rubrocyanin the maximum lies at about 90° C., but for Eastman infra-red sensitive plates the maximum is at 65°, and with Agfa 810 plates there is no increase of sensitivity with rise of temperature. Full details are given of the most satisfactory method of sensitising plates to infra-red radiation.
H. F. G.

1204. Resolving Power of Photographic Layers. H. Frieser. *Zeits. f. techn. Physik,* 12. 12. *pp.* 661–663, 1931.—The light falling upon a photographic layer is not solely utilised in producing the image, but is also diffused to neighbouring elements. The author endeavours to calculate this diffusion mathematically, and obtains two constants by which the resolving power can be defined. Applying the formulæ to the recording of sine waves, he finds that the diffusion only produces a reduction of amplitude increasing with the frequency, and shows no lack of linearity. An attempt to verify the results experimentally was marred by a lack of symmetry in the record. E. E. F. d'A.

1205. Fading of the Latent Image by Exposure to α-Particles. Mariette Blau. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 8. *pp*. 623–628, 1931.—Experiments are described whereby the density of the latent image is shown to be dependent on the time of exposure to α-particles, and the fading to approach a maximum. The interpretation of the phenomena is sought through a recrystallisation mechanism. H. H. Ho.

1206. Elementary Photochemical Process in Simple Crystals and the Electrical Detection of the Latent Image. R. Hilsch and R. W. Pohl. *Zeits. f. wiss. Phot.* 30. 9. *pp*. 255–261, *Nov*., 1931.—The appearance of bands at about 630 mμ in the absorption spectrum of potassium bromide after exposure to light is discussed. If such an exposed crystal is subjected to intense red light the primary photochemical change is reversed, and this reversal may be detected by applying a potential of 300 volts to the crystal and connecting a part of the surface to an electrometer; a deflection corresponding with 10^{-11} ampere-sec. has been observed under these conditions. The sensitivity of this method of detecting a primary photochemical change is exceedingly great. Possible applications are discussed. H. F. G.

1207. Obtaining Fine Grain Negative Images by Development. A. Lumière and A. Seyewitz. *Comptes Rendus*, 193. *pp*. 906–909, *Nov*. 16, 1931.—The use of paraphenylene diamine developer in the presence of caustic alkalis or carbonates often leads to clouded phototypes and a dichroic appearance if Na_2SO_3 or a feeble alkaline substance such as borax is present. Replacing the borax by small amounts of another substance acting as a caustic alkali avoids this and gives a fine grain image without clouding if development is prolonged. Intensification gives a non-dichroic black image of good gradation without appreciable increase of size of the grains. Four types of Lumière emulsions of different speeds show only a small change of size of grain after use of the paraphenylene diamine developer. This indicates that the developer acts in two phases, involving solution of AgBr and then precipitation of the dissolved Ag on the grains. R. S. R.

1208. Experimental Proof of the Spin of the Photon. C. V. Raman and S. Bhagavantam. *Indian Journ. Phys.* 6. *pp*. 353–366, *Oct*. 31, 1931. *Nature*, 128. *p*. 576, *Oct*. 3, *and p*. 727, *Oct*. 24, 1931.—The effect of photon spin on the light scattered by a rotating molecule is discussed. It is concluded that the intensities of the PP and RR branches will be one-half of the values given by classical theory. The "defect of polarisation" of the QQ branch will be much nearer that of the total scattering than is indicated by classical theory. The authors have tested the second point experimentally, using the gases CO_2 and N_2O as scatterers and light from a mercury lamp as the radiation. The results appear decisive in favour of the spin theory. Reasons why the theory should

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apply to liquids, with certain exceptions, are given. Experiments made with CS_2 and C_6H_6 are also favourable to the spin theory. N. D.

1209. Theory of Radiation. A. Proca. *Comptes Rendus,* 193. *pp.* 832–834, *Nov.* 9, 1931.—The author regards a photon as a particle and applies to it the laws of wave mechanics. Guided by Dirac's work, he derives relativistically a wave equation for the photon. This is transformed by generalising the concept of the nature of ψ, and assuming it to be a quaternion of the form $\psi_0 + \beta_1\psi_1 + \beta_2\psi_2 + \beta_3\psi_3$. It is shown that photon spin is to be expected from the properties of the new wave equation. Such an effect is obtained in recent work by Raman and others. [See preceding Abstract.] N. D.

1210. New Resonance Series of Selenium. W. Kessel. *Comptes Rendus, Polonaise,* 5. *pp.* 409–412, 1931. *French Abstract.*—Se vapour excited by a Cu arc emits a bright blue fluorescence. The Cu lines 4063 and 4023 excite the resonance series corresponding to the absorption bands found by Rosen. Two band formulæ are given which are shown to agree with the observed lines of the fluorescence spectrum. J. E.

1211. Complexity of the Resonance Series of Selenium Vapour. W. Kessel. *Comptes Rendus, Polonaise,* 5. *pp.* 413–423, 1931. *French Abstract.*—The examination of the fluorescent spectra of Se in detail, which the previous workers on this subject, Rosen and Ehrenfeucht, were unable to carry out, has here been done by using a very long tube of silica. The spectrum could be photographed in a few minutes with an instrument giving a dispersion of 1 Å. per mm. The optimum temperature for exciting both series is 600° C. Assuming a value of the moment of inertia calculated from the absorption spectrum, the doublet separation found in the two series gives values of 10 and 9 for the rotation quantum numbers. The principal doublets are accompanied by a number of much fainter lines which it is impossible at present to classify. J. E.

1212. Transition Probabilities and Quenching in the 3P State of Sodium. N. E. Berry and G. K. Rollefson. *Phys. Rev.* 38. *pp.* 1599–1611, *Nov.* 1, 1931.—The effect of foreign gases on the fluorescence of sodium vapour excited by the second line of the principal series has been investigated. The gases used were He, H and N, and the intensities of both the 3303 line and the D line were observed. The only positive effect obtained was that of He on the intensity of the D-line—a marked increase being observed. This is explained as due to a transfer of atoms from a 3^2P state to a 3^2D state by collisions. An increased Doppler width of the D-line was also observed which persisted up to pressures well over 100 mm. of He and caused a decreased absorption of the fluorescent light. The bearing of this work on the difference ratio of the 2^2S–3^2P and 1^2S–3^2P transitions as reported by Weiss [see Abstract 2199 (1929)] and Christensen and Rollefson [see Abstract 1021 (1930)] is discussed. An explanation of this difference based on the assumption that the life period of an excited atom varies inversely as transition probability of the radiation is offered. A new type of Na arc with increased intensity and stability of operation is described. J. E.

1213. Measurement of Fluorescence with a Photoelectric Cell. R. Toussaint. *Comptes Rendus,* 193. *pp.* 933–934, *Nov.* 16, 1931.—Measurements have been made, with the photo-colorimeter already described, of the ratio of the intensities of the fluorescent light in colouring matter to the intensity of the characteristic coloured light. It has been found for all the materials examined that this ratio is less than 1 %. The ratio reaches its maximum at the point of maximum purity of the characteristic colour. J. E.

1214. Absorption Spectra of the Alkyl Halides: Energies of the C-I and C-Br Bonds. T. Iredale and A. G. Mills. *Roy. Soc., Proc.* 133. *pp.* 430–439, *Oct.* 1, 1931.—Satisfactory agreement is found between the thermal energies of the bonds C-I and C-Br and the spectroscopic energies calculated from the long-wave limits of the continuous absorption bands of the alkyl halides in the near ultra-violet. It is concluded that dissociation into alkyl residues and excited halogen atoms undoubtedly takes place, and, if this is correct, there must be an excitation energy of the carbon atom from the divalent (^3P) to the tetravalent (^5S) state of 90–100 kcal. A tentative explanation is given of the shift of the absorption limits when the halides are liquefied as related to the changes in energy levels due to some form of molecular association. It is pointed out that the shifting of an absorption continuum towards the long or short wave region should not be likened to the broadening of a line or band at high pressures; whilst the two phenomena are related they must be interpreted differently. A. H.

1215. Absorption Spectrum of Potassium Permanganate. F. Vlès and A. Simchen. *Comptes Rendus*, 193. *pp.* 581–584, *Oct.* 12, 1931. —The visible and ultra-violet spectrum of $KMnO_4$, of concentration $6 \cdot 5 \times 10^{-4} M$, in buffered solution of pH 8·7 at 23°, consists of 21 bands: 63(5), 59(6), 570·0, 546·1, 524·0, 504·0, 485(·3), 47(2), 45(5), 43(5), 35(0), 34(2) ?, 333, 326, 318, 310, 304, 297, 290 ?, 24(0), and 230 mμ, given by (in the ultra-violet) $1/\lambda = 1/\lambda_0 + 725n$, and (in the visible) $1/\lambda = 1/\lambda_0 + 805 \cdot 5n - 0 \cdot 767n^2$. The two groups indicate two modes of molecular vibration. Position and strength of absorption vary slightly with the pH in the visible. In the ultra-violet the absorption ratio λ315/λ270, traced as a function of pH, indicates some ten successive states of the MnO_4' ion. The moment of inertia is therefore dependent on the pH. [See Abstracts 1202 (1919), 1249 (1921) and 655 (1930).] C. A. S.

1216. Absorption Spectra of Salts in Liquid Ammonia. R. W. Wood. *Phys. Rev.* 38. *pp.* 1648–1650, *Nov.* 1, 1931.—A preliminary investigation of the modifications in appearance and position of absorption bands of coloured metallic salts and organic compounds dissolved in anhydrous liquid ammonia. AUTHOR.

1217. Ultra-Violet Absorption Spectra of Aqueous Solutions of Chlorides. R. Tréhin. *Comptes Rendus*, 193. *pp.* 1089–1091, *Nov.* 30, 1931.—The absorption spectra of the chlorides of Na, K, Li, Ba and Sr between λλ2816 and 1990, determined as previously described [see Abstract 1221 (1931)] are similar *inter se*, but, save in very dilute solution, different from that of HCl. In such solutions, therefore, the absorption is due solely to the Cl^- ion, in more concentrated solutions the metallic kation in association with H_2O or Cl^- modifies the absorption differently from H^+. The absorption increases as λ decreases. A solution of LiCl can be obtained sufficiently concentrated to show a maximum absorption. C. A. S.

1218. Infra-Red Absorption Spectra and Electrolytic Dissociation in Mixed Organic Liquids. R. Freymann. *Comptes Rendus*, 193. *pp.* 928–930, *Nov.* 16, 1931.—1 % of ethyl or butyl alcohol can be detected in carbon tetrachloride by examining the infra-red absorption spectrum, through the intensity of the C–H bands at 0·9 and 1·0 μ. 0·1 % is detectable by that of the hydroxyl band at 0·9631 μ, this showing a maximum for 10–20 % and not disappearing until there is $< 0 \cdot 1$ %. This band behaves similarly if instead of carbon tetrachloride, chloroform, tetra- or tri-chloroethylene, allyl bromide, or benzene be used. This behaviour is attributed to electrolytic dissociation of the alcohol as in the case of nitric acid [see Abstract 3905 (1930)]. The displacement of the band, *e.g.*, to 0·9778 in benzyl alcohol, is associated with the presence of an ethylenic bond; this gradually disappears on dilution. A similar displacement is sometimes caused on adding an ethylenic compound to a saturated aliphatic alcohol. [See also Abstract 844 (1932).] C. A. S.

1219. Infra-Red Bands of Slightly Asymmetric Molecules. H. H. Nielsen. *Phys. Rev.* 38. *pp.* 1432–1441, *Oct.* 15, 1931.—As an aid in interpretation of infra-red bands, calculations are made on models of varying degrees of asymmetry, each characterised by a parameter ρ defined as the ratio of the least to the intermediate moment of inertia. The atoms in the molecule are restricted to lie in one plane. Three types of bands are found according as the electric moment vibrates along the least, intermediate or largest axis of inertia. Charts are given summarising the results of the calculations. F. S.

1220. Investigations in the Far Infra-Red by the Residual-Ray Method. J. Strong. *Phys. Rev.* 38. *pp.* 1818–1827, *Nov.* 15, 1931.—An instrument is described for investigations of the reflectivity, transmissivity and emission of various materials over the spectral range 20 to 150 μ. The following measurements are reported: Reflectivities of rough surfaces, galena, β-magnesia, zincite, stibinite, corundum, sphalerite, molybdenite and cuprite. Transmissivities of KBr, KI, a layer of KCl evaporated on a lacquer film, a thin film of amorphous quartz, liquid CCl_4 and powdered Al and Cu. Emission of liquid and solid NaCl near the melting temperature. [See also Abstract 3409 (1931).] AUTHOR.

1221. Infra-Red Spectrum and Molecular Configuration of N_2O. E. K. Plyler and E. F. Barker. *Phys. Rev.* 38. *pp.* 1827–1836, *Nov.* 15, 1931.—The three normal vibrations of N_2O are all active. The fundamental bands at 17·0 μ, 7·78 μ and 4·50 μ, and the three harmonics have all been observed; also six combination bands at wave-lengths greater than 2 μ. The 17·0 μ fundamental and two combination bands involving this fundamental have strong zero branches, while the harmonic and two combination bands involving the harmonic transition have no zero branches. All other bands are doublets. Three bands at 17·0 μ, 7·78 μ and 8·60 μ have been resolved under high dispersion. All show rotation lines with continuously varying intensities (no alternation) and almost uniform spacing, the same for each band, *viz.*, 0·84 cm^{-1}. The corresponding value of the moment of inertia, $59 \cdot 4 \times 10^{-40}$, is practically equivalent to that computed from the doublet separations of the various bands. The molecule is apparently linear but not symmetrical. The observations are not consistent with a triangular configuration, nor with the symmetrical linear configuration N–O–N, but they may be correlated precisely by means of the model $N \equiv N = O$. AUTHORS.

1222. Contributions of Molecular Spectra to Classical Chemistry. H. C. Urey. *Indust. and Engin. Chem.* 23. *pp.* 1241–1247, *Nov.*, 1931.—The experimental data of molecular spectra and the theoretical interpretation of these data give, primarily, information in regard to the energy states of molecules and their *a priori* probabilities. With the aid of the theoretical interpretation of these data, dimensions of molecules, the masses of the atoms of the molecules, the binding forces between the atoms, the dissociation energies, and electrical and magnetic moments can be deduced. Data of this kind of a most detailed character exist at the present time and are rapidly increasing in volume. In this paper some phases of the subject are presented. The methods of deriving the dissociation energies of diatomic molecules are reviewed and the problem of the triatomic molecule is discussed with particular reference to ClO_2 and SO_2. AUTHOR.

1223. Arc Spectrum of Rhenium. Part II. H. Schober. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 8. *pp*. 630–646, 1931.—Earlier work [see Abstract 3066 (1931)] is here extended to an investigation of the region 5400–8000 Å. using suitably sensitised plates. The number of lines now recorded is 228 compared to 14 in the same region given in the earlier paper. Of these, 22 principal lines are selected. The spectrum in this case was excited on copper electrodes. F. S.

1224. Arc Spectrum of Iodine. S. F. Evans. *Roy. Soc., Proc.* 133. *pp*. 417–430, *Oct*. 1, 1931.—A study is made of the spectrum of iodine, as excited by a h.f. electrodeless discharge, photographed in the first order of a 21-ft. grating, and also with a two-prism Littrow instrument. At a temperature of 40° C. the spectrum between λ4700 and λ10,481 is found to be almost entirely that of the neutral atom. The analysis shows the multiplet intervals to be very wide and the spacing between the electronic levels relatively small; as a consequence many lines lie in the region beyond the limit of sensitivity of the photographic plate. Use is made of hyperfine structure information in ordering the spectrum, but, owing to the cause mentioned above, a complete analysis has not proved feasible; further information, such as that given by the Zeeman effect, is required. The multiplets worked out are: in full, $6s \rightarrow 5p$, $7p \rightarrow 6s$; in part, $5d \rightarrow 6p$. The ionisation potential is estimated as 10·44 volts; this agrees well with Foote and Mohler's value of 10·4 volts as determined by an electrical method. A. H.

1225. Interferometric Measurements of the Iron Arc Spectrum in Air from λ3100 to λ3500. C. V. Jackson. *Roy. Soc., Proc.* 133. *pp*. 553–564, *Oct*. 1, 1931.—Forty-six iron lines have been compared with the cadmium red line and secondary standards of neon, using the previous apparatus [see Abstract 1899 (1931)]. Good agreement is found with the International Astronomical Union and with Babcock's values. The brightest neon line is found to have a wave-length of 5852·4875 Å. The red line of cadmium from a vacuum arc lamp agrees in wave-length with that from a Michelson tube to one part in 10^7. The wave-length of the brightest ultra-violet line of neon is 3520·4733 Å. F. S.

1226. Temperature Classification of the Spectra of Ytterbium and Lutecium. A. S. King. *Mt. Wilson Observat., Contrib. No.* 439. *Astrophys. J.* 74. *pp*. 328–341, *Dec*., 1931.—The spectra of ytterbium and lutecium produced by the electric furnace, arc and spark have been examined between λ2950 and λ6800 with regard to the segregation of neutral and enhanced lines, temperature classification, the occurrence of hyperfine structure and other distinctive features. The lines listed include

399 for ytterbium and 103 for lutecium. Widely separated energy-levels in the spectrum of neutral ytterbium are indicated by the very different response to the excitations used. About 70 % of the ytterbium lines listed belong to the ionised atom; these were placed in three groups according to the degree of enhancement in the spark. Neutral lutecium lines are in general strong in the furnace as compared with the arc, while the enhanced lines, with one exception, λ3507, require high excitation. The persistence of this line in the furnace indicates a low ionisation potential for lutecium. Hyperfine structure is present in about half of the lutecium lines examined, resolution of the components being obtained in some cases. Three-component lines seem to be of most frequent occurrence, and a tendency toward wider spacing in the patterns is found for lines appearing at low excitation. AUTHOR.

1227. Third-Order Spectrum of Oxygen: Quintuplets and Triplets of OIII. J. Gilles. *Comptes Rendus*, 193. *pp*. 584–586, *Oct*. 12, 1931.—From the results of Mihul and Fowler [see Abstracts 2045 (1927) and 1268 (1928)] the combinations $3p^5$D–$3d^5$D, $3p^5$D–$3d^5$P, $3p^5$PD–$4d^5$PDF, and $4s^3$P–$4p^3$P are tabulated. The terms established are a quintuplet P, a quintuplet D, and a triplet P near 46,000, 50,000, and 115,000 respectively, and two other quintuplets of which only the F-term is known. C. A. S.

1228. Forbidden Lines and Intensity Modifications of the Spectra of Mercury, Cadmium and Zinc under H.F. Excitation. J. Okubo and E. Matuyama. *Phys. Rev*. 38. *pp*. 1651–1655, *Nov*. 1, 1931.—With an oscillator of frequency 3×10^7 cycles per sec. the intensity modifications of the spectra of mercury, cadmium and zinc were studied. The singlet series and the intercombination lines which begin on the singlet levels were strengthened, as has been observed by previous investigators in the case of mercury, and the results were extended to the case of cadmium and zinc. Further, the intensity relations of the forbidden line $1S–2p_1$ of mercury were studied under this condition of excitation and also $1S–2p_{1,3}$ of cadmium were observed. The relations between the lines and the bands are discussed. Some consideration is also given to the conditions of excitation from the intensity modifications of lines. AUTHORS.

1229. Excitation of Continuous Spectra by Kathode-Ray Bombardment. Part IV. Investigation of Thorium and other Elements in the Presence of Gases. W. M. Cohn. *Zeits. f. Physik*, 72. 5–6. *pp*. 392–422, *Oct*. 21, 1931.—In this continuation of work [see Abstract 3824 (1931)], thorium, uranium and polonium are investigated when bombarded with electrons in gas at about 10^{-3} mm. pressure. A blue light is emitted from the surface of the element which is not polarised and has a continuous spectrum. The effect of various conditions of excitation on the distribution of energy in this spectrum is studied. F. S.

1230. Anomalous Dispersion of Excited Gases. Part VII. Electrically Excited Helium. S. Levy. *Zeits. f. Physik*, 72. 9–10. *pp*. 578–586, *Oct*. 30, 1931.—The anomalous dispersion at different lines of the positive column of helium has been investigated by Roschdestwensky's method. Some relative values of the transfer probabilities for the helium lines have been calculated. In addition, from the relation between the anomalous dispersion and the current, it has been deduced that the higher excitation states (2^1P, 2^3P, etc.) are produced by collisions with electrons, not directly from the normal state, but indirectly through the metastable 2^1S and 2^3S states. The characteristic influence of the pressure on the excitation of certain singlet and triplet states of He and of Ne is discussed. [For Part VI, see Abstract 839 (1931).] H. N. A.

1231. Average Life of the Ionised Helium Atom. L. R. Maxwell. *Phys. Rev.* 38. *pp.* 1664–1686, *Nov.* 1, 1931.—Electrons in helium at low pressure are confined into a narrow beam by a longitudinal magnetic field. A transverse electric field draws out the ions formed in the beam. The light is projected on the slit of a spectrograph with the direction of motion of the ions parallel to the slit. From previously developed formulæ the average life of the He^+ atom can be obtained by measuring the amount of the displacements of the region of maximum intensity of the spark line from the centre of the beam. It is found that (1) the average life becomes progressively greater for the higher quantum states in agreement with theory; (2) the average life of the sixth quantum state is $1 \cdot 1 \pm 0 \cdot 2 \times 10^{-8}$ sec.; the theoretical value is $1 \cdot 17 \times 10^{-8}$ sec. The resultant intensity distribution of the five components of the line 2733 Å. is calculated and found to be the same both with and without the assumption of free interchange of electrons among the sublevels. The experimental curve agrees well with the theoretical one. Discrepancies between the values for the matrix amplitude squared for hydrogen obtained by different authors are shown to affect the theoretical calculations given in this paper to only a small degree. It is also proved that electron spin corrections do not alter the theoretical interpretation of the experimental results. J. E. K.

1232. Faint Branches in the OH Bands. G. M. Almy and G. D. Rahrer. *Phys. Rev.* 38. *pp.* 1816–1817, *Nov.* 15, 1931.—Intense photographs of the OH bands in the near ultra-violet reveal a number of weak branches of the ^oP and ^sR types. The identification of these branches is made by a comparison of the observed wave numbers of the faint lines with their calculated wave numbers. No lines due to the molecule $O^{18}H$ were found, although under the conditions of the experiment they were to be expected. AUTHORS.

1233. Oscillator Intensities of the D-Lines. R. Ladenburg and E. Thiele. *Zeits. f. Physik,* 72. 11–12. *pp.* 697–699, *Nov.* 16, 1931.—From the older measurements of the number of dispersion electrons of the D-lines of sodium, deduced from magneto-rotations and from recent vapour-pressure measurements on sodium, the authors deduce that, taking into account the proportion of diatomic molecules in the vapour, the absolute values of the oscillator intensities are $f_{D_1} = 0 \cdot 35$ and $f_{D_2} = 0 \cdot 70$ with an accuracy of ± 3 %. The existing theoretical calculations give values 7 % smaller. The value of the length of the life of the two resonance states of the sodium atom derived from the experimental values of f is $T = 1 \cdot 48 \times 10^{-8}$ sec. f, f_{D_1} and f_{D_2} are the ratios between the number of oscillators per c.c. to the atomic density. H. N. A.

1234. Forms of the Light Waves which Represent a Black Temperature Radiation. J. Jaumann. *Zeits. f. Physik,* 72. 11–12. *pp.* 700–714, *Nov.* 16, 1931.—Deals with the difficult problem of the real nature of white light from a black body. It is recognised that it is not made up of an infinity of vibrations of different wave-lengths, and the observed spectrum depends on the properties of the observing instrument. White light is due to a rapid series of impulses given to the ether, which are completely aperiodic; but the author finds that it is possible to arrive at a mathematical expression for a single impulse, such that if a number of these are produced irregularly the total result will be the same as that actually observed. It is not postulated that the actual impulses have this special form. H. N. A.

1235. Intensity Measurements in the Neon Spectrum. W. Elenbaas. *Zeits. f. Physik*, 72. 11–12. *pp.* 715–723, *Nov.* 16, 1931.—The intensity relationships among the lines of the principal series of neon have been determined as a function of the current, pressure and diameter of the column of gas. In the region studied the distribution of intensity is independent of the current passing. The relative distribution of the $2p_2$ to $2p_9$ levels is independent of pressure and tube diameter, but with increase of the product of density and diameter $2p_1$ diminishes and $2p_{10}$ increases; this effect is ascribed to the distribution of the electron velocities, which also is a function of the product of density and diameter. H. F. G.

1236. Doppler Effect in Canal Rays in Neon. W. Romig. *Phys. Rev.* 38. *pp.* 1709–1715, *Nov.* 1, 1931.—The neon spectrum in the ultra-violet between 2500 Å. and 4000 Å. from a canal-ray tube was examined for Doppler effects. Potentials up to 24,000 volts were applied to excite the discharge. Doppler effects were found to be present among the stronger lines in the first and second spark spectra of neon and, with only two exceptions, were absent from the arc spectrum lines. About fifty strong and faint lines showing Doppler effects were observed. The canal-ray stream consists of rapidly moving neon atoms which radiate only when in the ionised state. Neon behaves similarly to argon at high voltages and differs from most gases in that the radiation from the canal rays is almost entirely from atoms in the ionised state. AUTHOR.

1237. Second Spark Spectrum of Boron, BIII. B. Edlen. *Zeits. f. Physik*, 72. 11–12. *pp.* 763–766, *Nov.* 16, 1931.—The results of earlier investigations are compared with new measurements of the vacuum-spark spectrum using a quartz spectrograph. In the region 5600–2000 Å., 14 lines are recorded belonging to BIII, and with the help of these and three extreme ultra-violet lines the term system is amended and extended. F. S.

1238. Isotope Effect in the Band Spectrum of LiH. G. Nakamura. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 303–306, *Oct.*, 1931.—The band spectrum of LiH was analysed in a previous paper [see Abstract 2171 (1930)]. This spectrum has since been photographed under much improved conditions of excitation. Many previously faint lines now appear greatly enhanced and new lines are discovered. Most of the enhanced and the new lines are shown to originate from the lighter isotope molecule Li^6H. The intensity ratio of the lines of the two molecules, Li^7H and Li^6H, varies with the excitation conditions from 2 : 1 to a stationary value of 8 : 1. This latter value agrees with the intensity ratio obtained by Wijk and Koeveringe from measurements of the band spectrum of Li_2. J. E. K.

1239. Interpretation of Hyperfine Structure in TlII. Relative g(I) Factors and Nuclear Structure of Tl, Bi and Pb^{207}. J. C. McLennan, A. B. McLay and M. F. Crawford. *Roy. Soc., Proc.* 133. *pp.* 652–667, *Oct.* 1, 1931.—By the use of formulæ, derived by Goudsmit by the method of energy sums, for the interaction energy of the valence electrons of an atom with the nucleus, the interaction constants "*a*" of electrons in various states are calculated from the observed TlII hyperfine structure separations. The constant a_{6s} is calculated from nine configurations of the TlII atom, and its variation indicates clearly the screening effects of the various outer electrons. The constants a_{6s}, a_{7s}, a_{8s} show the expected trend of value. Inconsistencies in the value of "*a*" for *p*-electrons provide further evidence that the formulæ for "*a*" are incorrect for electrons other than those of the *s*-type. The *g*(I) factors of Tl, Bi and Pb^{207} are calculated. The factor *g*(I) for Tl is about four times bigger than *g*(I) Bi and *g*(I) Pb^{207}. If the nuclear moments were due in each case to spinning protons only, the three *g*(I) factors should be equal. The assumption that nuclear moment is due to proton spin only is therefore inadequate. Comparison with the extra-nuclear structure suggests that the nuclear electrons may possess an orbital motion; this would explain the variation of the *g*(I) factor. J. E. K.

1240. Hyperfine Structure and Zeeman Effect of the Resonance Lines of BaII. R. Ritschl and R. A. Sawyer. *Zeits. f. Physik*, 72. 1–2. *pp*. 36–41, *Oct*. 5, 1931.—The resonance lines 4934 and 4554 of BaII are photographed with a Schüler lamp, cooled with liquid air, and a Fabry–Pérot étalon. Each line possesses hyperfine structure and shows three components. The behaviour of the lines in a magnetic field is investigated with the aid of a water-cooled solenoid of 1000 turns as well as with a large Weiss electromagnet. The assumption that the hyperfine structure is due to Ba^{136} and Ba^{138} with zero nuclear moment and to Ba^{137} with a positive nuclear moment is in agreement with the magnetic behaviour of the components. J. E. K.

1241. Hyperfine Structure of HgH Bands. S. Mrozowski. *Zeits. f. Physik*, 72. 11–12. *pp*. 776–784, *Nov*. 16, 1931.—Analysis of the line-structure of the bands 4520, 4394, 4219, 4017 Å. establishes the complex nature of the lines. Every band-line consists of three components, whose difference in wave-number is constant, and approximately equal to 0·1 $cm.^{-1}$, along all bands. In strong bands, the existence of a fourth component seems probable. Theoretical explanations of the phenomena are suggested. G. C. McV.

1242. Hyperfine Structure of Spectral Lines. Part I. K. Murakawa. *Zeits. f. Physik*, 72. 11–12. *pp*. 793–797, *Nov*. 16, 1931.—The hyperfine structures of lines in the spectra of PbI, PbII, ZnI, MgI and SnI are investigated. High resolution is obtained with a 7·4 mm. quartz Lummer–Gehrcke plate and a Hilger echelon grating of 35 plates; the exciting source is a Schüler lamp. From the structure of λ4058 of PbI and λλ4242, 4245 and 5373 of PbII, it is concluded that the isotope Pb^{207} has a nuclear moment $I = \frac{1}{2}$ and that the isotopes Pb^{206} and Pb^{208} have $I = 0$. Five MgI lines, five ZnI lines and one SnI line are found to be of single structure, the nuclear moment $I = 0$ is therefore allocated to these elements. J. E. K.

1243. Hyperfine Structure of Spectral Lines. Part II. K. Murakawa. *Zeits. f. Physik*, 73. 5–6. *pp*. 366–375, *Dec*. 10, 1931.—In a previous paper [see Abstract 862 (1932)] the nuclear moments of thei sotopes of mercury have been determined from a study of the Zeeman effect of the hyperfine structure of λ4047 of HgI. The isotope

Hg^{204}, Hg^{202}, Hg^{200} and Hg^{198} have $I = 0$, Hg^{199} has $I = \frac{1}{2}$ and Hg^{201}, $I = \frac{3}{2}$. This determination is now used for the interpretation of the hyperfine structure of λλ4078, 4358, 5461, 2753, 2894, 3341, 2536 and 4916 of HgI. Tables are given showing the hyperfine structure separations of the terms of the odd isotopes and the relative displacements of the levels of the even isotopes. A brief survey of the established nuclear moments of the elements shows that the electrons cannot possess a spin $I = \frac{1}{2}$ in the nucleus. J. E. K.

1244. Spectra of Two-Electron Systems. M. H. Johnson, Jr. *Phys. Rev.* 38. *pp.* 1628–1641, *Nov.* 1, 1931.—Following the method of Güttinger and Pauli [see Abstract 2300 (1931)], four angular momentum vectors are treated in matrix mechanics. Analytic formulæ are obtained for the matrix components of the spin-orbit interaction of two electrons in LS coupling. Since the electrostatic energy in LS coupling is a diagonal matrix whose elements may be calculated by Slater's method, this gives the complete energy matrix. Then for any two-electron configuration one easily obtains the secular equations whose roots give the energy levels in intermediate coupling. In this manner the secular equations are worked out for the configurations p^2, $p \cdot p$, d^2, $d \cdot d$, and $d \cdot p$. AUTHOR.

1245. Zeeman Effect in Intermediate Coupling. D. R. Inglis and M. H. Johnson, Jr. *Phys. Rev.* 38. *pp.* 1642–1647, *Nov.* 1, 1931.—A method is given for calculating *g*-values in intermediate coupling when the matrix of internal energy of the atom (spin-orbit plus electrostatic interaction) is known in LS coupling. The transformation from the states of LS coupling to the states of intermediate coupling, in which the internal energy matrix is diagonal, is then readily determined in terms of the parameters expressing the relative magnitudes of the interactions. The coupling parameters are ascertained from the measured energy levels. The transformation so determined is applied to the matrix of the energy due to an external magnetic field, as known for LS coupling. The diagonal terms of the transformed matrix contain the *g*-values of the states of the atom in intermediate coupling. Application of the method is made to the configurations p^2, p^3 and d^2. Agreement with the available experimental *g*-values is satisfactory, being as good as the agreement of energy levels to be had from a first order calculation. AUTHORS.

1246. Zeeman Effect with the Quadruple Lines of the Alkali Metals. E. Segrè and C. J. Bakker. *Zeits. f. Physik*, 72. 11–12. *pp.* 724–733, *Nov.* 16, 1931.—Study of the behaviour in a magnetic field of the first $^2S - {}^2D$ combination of sodium and potassium has confirmed the Rubinowicz theory of quadruple emission. H. F. G.

1247. Raman Spectrum in Ammonia Solutions. V. Ricca. *Accad. Lincei, Atti*, 14. *pp.* 197–200, *Sept.*, 1931.—Aqueous solutions of ammonium salts present no Raman lines attributable to the ion NH_4. Aqueous solutions of ammonia give the same Raman spectrum as liquid ammonia. Hence we may conclude that ammonia in aqueous solutions is either in the state of NH_3 or NH_4OH. E. E. F. d'A.

1248. Raman Effect in Terpenes. G. B. Bonino and P. Cella. *Accad. d' Italia, Mem.* 2. 4. (*Chim.*), [51 *pp.*], 1931.—The spectra were examined with a Zeiss spectrograph, giving 50 Å. per mm. at 410 $\mu\mu$, using a mercury-vapour lamp as source, and either utilising the whole radiation, or with a saturated solution of quinine bisulphate as filter. The substances examined were dextro- and lævo-pinene, sabinene, limonene, menthene, pinane, sabinane and menthane. The last three were prepared by hydrogenation of *l*-pinene, sabinene and limonene respectively. It was found essential to re-distil all the products a number of times. The results for the frequency differences from 12 lines in the mercury spectrum are given in the form of tables, both with and without the filter in each case. It is found that the results for *d*- and *l*-pinene are practically identical. The shifted lines for all the substances are grouped as those due to the CH group, those due to a double bond, those due to the CH_2 group, those with frequency difference less than 1000 cm.$^{-1}$, those depending on stereochemical differences and those related to the infra-red absorption bands. Each group is discussed in detail. In the first group are the lines shifted 2865 and 2925 cm.$^{-1}$, which were found in every terpene and also in cyclo-hexane, decahydronaphthalene and in some open chain saturated hydrocarbons. Similarly a shift of 3080–3090 cm.$^{-1}$ is found whenever the group $XC = \overset{|}{\underset{|}{C}}-H$ is present. Another generalisation is to the effect that all the shifts below 1000 cm.$^{-1}$ (12 for pinene) are linear combinations of three fundamental shifts. J. H. A.

1249. Raman Effect in Acid Derivatives and Esters. V. N. Thatte and A. S. Ganesan. *Phil. Mag.* 12. *pp.* 823–832, *Oct.*, 1931.—Raman spectra are recorded for the liquids acetic anhydride, mono-, di- and trichloracetic acid, and amyl nitrate (*iso*-); allyl isothiocyanate, ethyl oxalate and acetyl and benzoyl chlorides. The mono- and trichloracetic acids were in aqueous solutions. A. C. M.

1250. Raman Effect in Benzene and Toluene Under High Dispersion and Resolving Power. L. E. Howlett. *Canad. J. of Research*, 5. *pp.* 572–579, *Nov.*, 1931.—The six-prism spectrograph, used by J. S. Foster [see Abstract 3442 (1930)] for his work on the Stark effect, was employed in the investigation. It was found that a number of entirely new lines were observed in the Raman spectrum of both liquids. Some of these are due to the separation into components of previously observed lines; others are entirely new. Accurate measurements are given of the Raman frequency shifts and comparison with other results is afforded. AUTHOR.

1251. Raman Effect in Organic Compounds. M. E. High. *Phys. Rev.* 38. *pp.* 1837–1844, *Nov.* 15, 1931.—The Raman spectra of the normal and *iso* forms of propyl ether, amyl ether, propyl propionate, butyl propionate, amyl propionate, and also methyl propionate have been measured. Certain characteristic frequencies remain unchanged throughout the series, but other frequencies which appear singly in the normal forms are split into several frequencies in the *iso* forms, due to the rearrangement of the atomic groups. The Raman spectra have also been observed in the ortho, meta and para forms of chlorotoluene, cresyl methyl ether, nitrochlorobenzene and nitrotoluene. In addition to the characteristic frequencies which remain unchanged there are certain frequencies which consistently increase from the ortho to meta to para forms. Similar increases are noted in the infra-red absorption spectra of the xylenes. AUTHOR.

1252. Raman Effect in Amorphous and Crystalline Solids. A. Hollaender and J. W. Williams. *Phys. Rev.* 38. *pp.* 1739–1744, *Nov.* 1, 1931.—There have been photographed the Raman spectra of several specimens of plate glass and of certain crystalline sulphates and their water solutions. In the case of the plate glass it is shown that at least most of the lines owe their origin to the silica content. The data for the crystalline sulphates are of interest because of the appearance of lines corresponding to both the active and inactive frequencies of the sulphate ion. These lines also make their appearance when the crystals are dissolved in water. With the data now available in the literature it is difficult to describe exactly the shifts of the Raman lines produced by the solution process because these shifts frequently depend upon the concentrations of the ions and for a given concentration different lines may be shifted by different amounts. AUTHORS.

1253. Influence of Substitutions on the Raman Frequency of the Ethylenic Radiation. M. Bourguel. *Comptes Rendus,* 193. *pp.* 934–937, *Nov.* 16, 1931.—Two laws have already been fixed for the Raman frequency of the acetylenic linkage, *viz.* (1) it is fixed whatever the compound when the linkage is at the end of a chain, (2) its frequency increases when groups such as CH, Cl, CO_2CH_3 are substituted for the terminal hydrogen [see Abstract 3737 (1930)]. With a spectroscope of greater dispersion these laws have been found again for the ethylenic linkage except that the change due to the substituents depends in sense on their nature—alcohols and halogens giving opposite shifts. Thus the frequency increases when one or more of the ethylenic H atoms are replaced by alcoholic radicals and decreases when replaced by a halogen, in each case the change being larger the more substitutions are made. J. E.

1254. Raman Effect and Chemical Constitution. Cyclopropane Nucleus. R. Lespieau, M. Bourguel and R. Wakemann. *Comptes Rendus,* 193. *pp.* 1087–1089, *Nov.* 30, 1931.—Cyclopropane has Raman lines at 1188, 3011 and 3028 cm.$^{-1}$ and bands with centres at 867, 1439 and 3076. Comparison with the Raman spectra of methyl-, dimethyl-, methylethyl-, methylpropyl-, phenyl- and diphenyl-cyclopropanes shows that the C—C linkage in the C_3 nucleus is characterised by a strong line near 1188 (1208, 1214, 1209 and 1221, 1207 and 1221, 1221, 1227 respectively). This line increases in frequency with increased molecular weight, and becomes a doublet when there are two different substituents. The C—H linkage is characterised by a line or pair of lines, between 2999 and 3028, and a band between 3061 and 3076, resembling the ethylenic spectrum. C. A. S.

1255. Reflection of X-Rays. B. Demetrovic. *Comptes Rendus,* 193. *pp.* 579–581, *Oct.* 12, 1931.—On passing a beam of X-rays perpendicularly to the axis of a hollow cylinder in a block, or of a tube, of various materials (metal, carbon, ebonite, etc.) and receiving it on a photographic film, two white lines with ill-defined edges bounding the shadow of the cylinder are found on development, explicable as due to reflection of the X-rays near the generatrix touched tangentially by the beam. If X-rays impinge similarly on a sensitive film rolled cylindrically, similar lines are obtained at corresponding positions, the width varying with the radius of curvature, and precise form differing according as the sensitive film is convex or concave. All these effects are due to reflection of X-rays, which is strongest at the angle of total reflection—calculated roughly as not exceeding 2°. [See Abstracts 1052 (1919), 2197 (1923), 992 (1926) and 3078 (1929).] C. A. S.

1256. Total Reflection of X-Rays. H. Kiessig. *Ann. d. Physik*, 11. 5. *pp.* 645–648, *Oct.* 27, 1931.—An attempt to reconcile apparently contradictory results obtained by Edwards [see Abstract 2322 (1931)] and by the author [see Abstract 135 (1932)]. C. B. A.

1257. X-Ray Powder Diffraction Apparatus of New Design. T. M. Hahn. *Rev. Sci. Instruments*, 2. *pp.* 626–631, *Oct.*, 1931.—The X-rays, originating at the apex of the cones, are passed through a slit formed by the space between a hollow and a solid cone of semi-vertical angle α (about 11°). The sample under examination forms a circular ring, of radius R, closing the distant end of the conical slit. The diffracted rays then form a series of right circular cones, of semi-vertical angle 2θ, which intersect at various points along the axis of the slit cone. The sensitive film is placed either so that this axis lies along its centre line or perpendicular thereto. In the first case the diffracted rays form faint lines intersecting in bright spots on the axis, distant $R/\tan(2\theta - \alpha)$ from the plane of the sample; in the latter a series of concentric circles. Full details of construction are given. C. A. S.

1258. X-Ray Camera for Powder Diagrams at any Temperature. N. W. Taylor. *Rev. Sci. Instruments*, 2. *pp.* 751–755, *Nov.*, 1931. —A cylindrical X-ray camera of about 57 mm. dia. has been designed which may be used for powder photographs (Hull–Debye–Scherrer method) up to 1000° C. or down to liquid air temperatures. Convenience in use is obtained by placing the film on the outside rather than the inside. Using a Siegbahn-type X-ray tube with Cu or Fe antikathode and 15 to 20 mA tube current, good diagrams may be obtained in from ten minutes to two hours, depending on the substance being investigated. The method permits the study of those crystal modifications which are stable at high or low temperatures but unstable at room temperature. Lattice constants may be determined with an accuracy of 0·2 %. AUTHOR.

1259. Intensity of Total Scattering of X-Rays by Monatomic Gases. H. Y. Woo. *Tsing Hua Univ., Sci. Reports, Ser. A.* 1. 2. *pp.* 55–67, 1931.—Raman and Compton have recently independently derived an expression for the total scattering of X-rays by matter, on the basis of the electromagnetic theory, which seems to take account both of the coherent and incoherent scattering. The author calculates according to their formula the intensity of the X-rays scattered by the atoms of a monatomic gas. The theoretical results obtained are compared with the experimental results of Barret and of Scherrer and Staeger. The agreement appears to be satisfactory. H. N. A.

1260. Total Scattering of X-Rays by CCl_4 Vapour. S. S. Lu. *Tsing Hua Univ., Sci. Reports*, 1. *pp.* 111–118, *Oct.*, 1931. *In English.*—A formula has been derived by Y. H. Woo [see Abstract 137 (1932)] for the scattering of X-rays by polyatomic gases, on the assumption that only the coherent radiations scattered by the different atoms in the molecule will interfere with one another, while the incoherent radiations will be simply added up. The expression for the intensity contains two terms; the first is the well-known expression derived by Debye, while the second represents the incoherent intensity due to the scattering by all the atoms composing the molecule. The expression for the intensity contains F, the atomic structure factor; this F has been derived by Fermi and also by Hartree. The author has calculated the results for CCl_4 on Woo's and Debye's theories, with Fermi's and Hartree's values for F, and he gives diagrams to compare the results with the experimental data. These show that the best coincidence between theory and experiment is given by Woo's theory with Hartree's F. He also gives the theoretical data for MoKα radiation; but unfortunately Debye's experimental curve for this has not been published. A. D.

1261. Incoherent Scattering of X-Rays. W. Heisenberg. *Phys. Zeits.* 32. *pp.* 737–740, *Oct.* 1, 1931.—In investigating the structure of polyatomic molecules by means of X-rays, it is important to know the scattering effect of a single atom. Whereas the coherent part of this scattering could be determined to a sufficient degree of approximation from the density-distribution suggested by Thomas and Fermi, the incoherent scattering could be obtained only by summing up the amounts contributed by the individual electrons according to the formulæ of Waller. In the present paper the author arrives at an approximate formula for the incoherent scattered radiation by a method formally analogous to that of Thomas and Fermi. The formula fails in the case of small nuclear charges and also in that of very heavy atoms. In atoms of medium weight the incoherent radiation is very feeble in comparison with the coherent radiation and the assumption contained in the formulæ is very approximately fulfilled. [See also following Abstract.] H. L. B.

1262. Incoherent Scattering of X-Rays. L. Bewilogua. *Phys. Zeits.* 32. *pp.* 740–744, *Oct.* 1, 1931.—The formula obtained by Heisenberg [see preceding Abstract] is evaluated numerically. The results are compared with those obtained experimentally for argon and neon (by Wollan). The influence of the incoherent scattered radiation on the interference patterns of polyatomic molecules is exemplified in the case of carbon tetrachloride and benzol. H. L. B.

1263. Scattering of X-Rays in Water. E. Amaldi. *Phys. Zeits.* 32. *pp.* 914–919, *Nov.* 15, 1931.—Measurements have been made of the scattering of CuK_α and MoK_α radiation by water at 20° and 45°. The theoretical significance of the results is discussed. Interpretation of the characteristic curve is difficult, as the maxima and minima have no clear relationship to simple frequencies in the liquid; further, it is not possible to ascribe the temperature effect observed to association phenomena, and the most that can be stated is that the intensity variation between 0·5 Å. and 2·90 Å. becomes smaller at higher temperatures. A small change of molecular symmetry causes the appearance of very complicated relationships, and interference in liquids cannot be directly interpreted in terms of a definite molecular orientation. H. F. G.

1264. Dispersion of X-Rays in Calcite. L. A. Pardue. *Phys. Rev.* 38. *pp.* 1808–1815, *Nov.* 15, 1931.—The dispersion of X-rays in calcite has been investigated. The total radiation and the $K\alpha_1$ line from a molybdenum target tube operated at about 44,000 volts were used in different experiments. The decrement of unity in the index of refraction for the $K\alpha_1$ wave-length was found to be $(2{\cdot}001 \pm 0{\cdot}009) \times 10^{-6}$. This does not agree with the value computed on the Drude-Lorentz theory. The specimen was a right prism with the optic axis parallel to the 90° refracting edge. No evidence was found for double refraction. The intensities of $\mathrm{MoK}\alpha_1$ radiation reflected from calcite mirrors were measured for angles in the neighbourhood of the critical angle. These experimental values were compared with the values computed on the basis of Thibaud's modification of Fresnel's equation and found to be in fair agreement.

AUTHOR.

1265. Kramers' Theory of X-Ray Absorption. A. Ganguli. *Indian Journ. Phys.* 6. *pp.* 453–457, *Nov.* 30, 1931.—The author adopts a method which has been used in connection with thermionic emission, to deduce independently Kramers' expression for the atomic absorption coefficient. He also employs another method, which closely resembles that of Kramers, and makes use of the number of bound electrons as determined by Kar and Ganguli; he obtains the number of free electrons having velocity between v and $v + dv$. From this the same expression for the atomic absorption coefficient follows. H. N. A.

1266. X-Ray Diagram Lines Strongly Absorbed in the Absorption Spectra. S. Kawata. *Kyoto Coll. Sci., Mem.* 14. *pp.* 227–228, *Sept.*, 1931.—Continuing his research on the origin of the X-ray absorption edge [see Abstract 2704 (1931)], the author adopted the method of determining the relative position of the emission line and the corresponding absorption limit from the diminution of the intensity of the line passing through an absorbing screen of the same element. It was found that (1) $\mathrm{L}\beta_5$ lines of W and Pt were strongly absorbed, (2) the Au $\mathrm{L}\beta_5$ line was absorbed somewhat more than other lines on the longer wave-length side of the edge, and (3) the $\mathrm{CuK}\beta_2$ and the $\mathrm{PtL}\gamma_6$ lines were only slightly absorbed. From these results an explanation of the origin of the absorption limit is propounded. [See also following Abstract.] AUTHOR.

1267. X-Ray Diagram Lines Absorbed by a Screen of the Same Element as the Radiator. S. Kawata. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 317–328, *Dec.*, 1931.—Former research [see preceding Abstract] is extended. Here the investigations are made on (1) the $\mathrm{AuL}_{\beta 5}$ line after passing through Au foils with masses of 10, 20 and 30 mg. per sq. cm., (2) the lines $\mathrm{NiK}_{\beta 2}$, $\mathrm{ZnK}_{\beta 2}$, $\mathrm{TaL}_{\beta 5}$, and $\mathrm{WL}_{\gamma 6}$ after passing through screens of metallic Ni, Zn, Ta and W, and (3) the lines $\mathrm{CuK}_{\beta 2}$, $\mathrm{WL}_{\beta 5}$ and $\mathrm{AuL}_{\beta 5}$ after passing through the screens of CuO, $\mathrm{CaWO_4}$ and $\mathrm{AuCl_3}$. The results are summarised in a table. AUTHOR.

1268. Variation of the K Spectrum of Sulphur, Produced by X-Ray Excitation, with the Nature of the Chemical Linkage. A. Faessler. *Zeits. f. Physik,* 72. 11–12. *pp.* 734–743, *Nov.* 16, 1931.—Previous work is reviewed. The wave-lengths of the K_{α_1} and K_{α_2} lines of sulphur in the elementary form and in thiocyanates, thiosulphates, sulphides and sulphates have been measured. In sulphides the lines are displaced towards the longer wave-lengths, whilst in sulphates the displacement is towards the shorter wave-lengths and is approximately constant for all the compounds examined. Various phenomena which have been attributed to a relationship between the emission and the nature of the chemical linkage concerned are shown to be due merely to the thermal and electrical action of the kathode stream. Thus the K_{α} triplet reported in the spectrum of sulphates arises from the doublet of the sulphate and the superimposed doublet of liberated sulphur. The secondary emission method, on the other hand, yields results free from any such complication. The wave-lengths of the doublet lines emitted by the sulphates are 5357·99 and 5360·83 X.U. The distance between the K_{a_1} and K_{a_2} lines is constant for sulphur, sulphides and sulphates. Thiosulphates emit a triplet produced by superimposition of the two doublets arising from di- and hexavalent sulphur, respectively. H. F. G.

1269. Structure of Soft X-Ray Lines. W. V. Houston. *Phys. Rev.* 38. *pp.* 1797–1801, *Nov.* 15, 1931.—The experimental work on soft X-rays has shown that the lines produced by the bombardment of a solid target are much broader than those emitted by a vapour. This is due to the fact that the upper level is not sharp. The breadth and the shape can be calculated from the various models which have been used for describing the behaviour of electrons in metals. The free electron model gives a line which has a sharp edge on the short wave-length side. This is not observed in Be. The calculated width, however, agrees well with the observed. The bound electron model gives a more satisfactory shape for Be, but the width cannot be exactly determined. The comparison of the line shapes calculated on the basis of these two models with that observed in Be shows that, although the free electron model gives a good approximation to the zero point energy, the distribution of energy levels is strongly affected by the periodic potential in the crystal. AUTHOR.

1270. Upper Atomic-Number Limits for Satellites of the X-Ray Line $L\beta_2$. R. D. Richtmyer. *Phys. Rev.* 38. *pp.* 1802–1807, *Nov.* 15, 1931.—The region of the X-ray spectrum in the immediate neighbourhood of the line $L\beta_2$ has been photographically studied for the elements of atomic number 50, 51, 52, 53, 56, 58 and 60, with a view to determining more precisely the atomic number ranges of the satellites (five in number) of $L\beta_2$. It appears that these ranges have clearly defined upper limits in the cases of all but one of the satellites of $L\beta_2$, and that the previously supposed presence of these satellites beyond these limits, approximately atomic number 53, can be traced in some cases to certain diagram lines which had not heretofore been thoroughly investigated, and that the presence of the satellites beyond these limits is in general to be doubted, at least as far as present accuracy and sensitivity of observation are concerned. The existence and sharpness of these limits seem to be in conflict with the Wentzel–Druyvesteyn double-ionisation theory of the origin of the satellites. A table of new wave-lengths is included. AUTHOR.

1271. Absorption of Soft X-Rays in Gases. R. G. Spencer. *Phys. Rev.* 38. *pp.* 1932–1937, *Dec.* 1, 1931.—A crystal spectrograph is described which has been constructed for measuring absorption coefficients of soft X-rays in gases, and with it the absorption coefficients of air, argon and oxygen were measured for spectral lines of wave-lengths 1·537, 2·284, 4·145 and 6·973 Å. In the regions immediately adjacent to the K absorption limit of argon the absorption coefficients were measured with general radiation, and within these regions no departure from the ordinary absorption law greater than that due to experimental error was found. The magnitude of the K absorption discontinuity of argon was also measured (1) by a method which is independent of the extrapolation of curves to the absorption limit, and (2) by a method which is independent of the absolute magnitude of the absorption coefficients on either side of the absorption limit. AUTHOR

RADIOACTIVITY.

1272. Present Status of Theory and Experiment as to Atomic Disintegration and Atomic Synthesis. R. A. Millikan. *Roy. Astron. Soc., Canada, J.* 21. *pp.* 361–370, *Oct.*, 1931.—A general report on the subject contained in a lecture to the American Association for the Advancement of Science. A great deal of attention is devoted to the work of the author and other observers on cosmic rays. Recent observations lead to the conclusion that these rays enter the earth's atmosphere as a practically pure photon beam. This implies that the rays before entering the atmosphere have passed through very little matter, as otherwise they would be accompanied by secondaries, β-rays and photons of reduced frequency. This agrees with the fact that the earth's magnetic field does not seem to affect the intensity of the rays. The author considers that the above proves that the rays cannot originate even in the outer atmospheres of the stars, but rather from the intensely cold regions in the depths of interstellar space. The cosmic rays appear to be due to the building up at their places of origin of the commoner heavy elements out of hydrogen. Hydrogen, helium, oxygen, nitrogen, carbon and even sulphur have been found by Bowen in the nebulium lines, which originate between the stars. The author suggests very tentatively that the hydrogen may be replenished from the radiant energy passing through empty space. H. N. A.

1273. Thermo-Equilibrium of Atom-Nuclei at High Temperatures. S. Suzuki. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 277–281, *Nov.*, 1931. *In English.*—The thermo-dissociation of atom-nuclei is re-examined in the light of wave mechanics. The author's conclusions formerly obtained [see Abstract **1497** (**1930**)] hold good except for minute points. Dividing the process of nuclear dissociation into three classes, it is shown that the final product at extremely high temperatures is α-particles, protons and electrons. Further it is pointed out that the thermic origin of heat-supply of a star either from the nuclear thermo-recombination of elements or from the annihilation of protons and electrons in the degenerated state is untenable to explain the long life of stars. AUTHOR.

1274. Mathematical Equivalence of Two Ways of Regarding the Excitation of an Atom by a Rapidly Moving α-Particle. J. W. Frame. *Cambridge Phil. Soc., Proc.* 27. *pp.* 511–517, *Oct.* 31, 1931.—One way of dealing with the problem is by solving the Schrödinger equation for the system α-particle and atom; in the other the α-particle can, on account of its great mass as compared with the electrons, be treated as a moving centre of force, the Schrödinger equation for the electrons in the field of the α-particle and the nucleus being solved. If v the velocity of the α-particle is greater than the orbital velocities of the electrons approximate formulæ for the excitation probabilities can be obtained by both methods, which formally are very, very different from one another; but which are shown by the author to lead to identical results if the ratio of the mass of the electron to that of the α-particle is considered as vanishingly small. H. N. A.

1275. Theory of Excitation by Collision with Heavy Particles. N. F. Mott. *Cambridge Phil. Soc., Proc.* 27. *pp.* 553–560, *Oct.* 31, 1931.—Shows that the two methods of treating collision between atoms and α-particles or other atoms (1) by treating the α-particle as a moving centre of force, as was done by Gaunt, and (2) by the Born method in which the incident α-particle is treated as a wave (used by Bethe), give the same result when properly carried out. Gaunt's result was unsatisfactory owing to certain approximations made by him. The somewhat idealised case of the collision between an α-particle and an atom, consisting of a single electron bound in the field of an infinitely heavy nucleus, is first dealt with, and it is shown that the same probabilities of excitation result when either of the two above methods is employed. The author also discusses to what extent the first approximation of Born is likely to be correct for slow α-particles and positive ions, and gives a method by which better results could be obtained. H. N. A.

1276. α-Rays of Long Range from Thorium C + C′, and Determinations of Velocities of α-Rays. S. Rosenblum. *Comptes Rendus*, **193.** *pp.* 848–850, *Nov.* 9, 1931.—On investigating by the magnetic method [see Abstract 3465 (1930)] the velocities of the 11·5 cm. group of α-rays of thorium C + C′, a new ray, α_I, of velocity 1·098 times that of the α-ray of thorium C′ was observed, and probably a second, α_{II}, of relative velocity 1·037, belonging to the 9·7 cm. group. The energy differences are $E_{\alpha I} - E_{\alpha ThC'} = 1827 \pm 40$ *ekv*, and $E_{\alpha II} - E_{\alpha ThC'} = 663$ *ekv*. The velocities of the α-rays of Ac and AcC′ similarly determined by comparison with those of RaC′ are respectively $1 \cdot 782$ and $1 \cdot 893 \times 10^9$ cm./sec. C. A. S.

1277. α-Particles from Thorium C and Actinium C. (Lord) Rutherford, C. E. Wynn-Williams and W. B. Lewis. *Roy. Soc., Proc.* 133. *pp.* 351–366, *Oct.* 1, 1931.—Determined by the previously described method, save that the counting was automatic [see Abstracts 3856 (1931) and 146 (1932)], the long range (> 9·1 cm. in air) α-particles from thorium C consist of only two groups of extrapolated ranges 9·781 and 11·662 cm., energies $9 \cdot 512$ and $10 \cdot 624 \times 10^6$ e.v., and relative numbers 1 : 5·6, the actual number of the latter being $1 \cdot 9 \times 10^{-4}$ of that of the main (8·62 cm.) group. No trace of particles of greater range was found. The origin of these particles is discussed [see Abstract 150 (1932)]. With a stronger source of actinium C [see Abstract 3857 (1931)] the α-particles therefrom of range > 4·4 cm. consist of two groups, together with a group from actinium C′ of extrapolated range 4·972, 5·426, 6·572; energies $6 \cdot 254$, $6 \cdot 597$, $7 \cdot 421 \times 10^6$ e.v., and relative numbers 19, 100, 0·32, respectively. If there are particles of higher range their relative number is less than 3×10^{-3}. C. A. S.

1278. Scattering of α-Particles by Light Elements. W. Riezler. *Roy. Soc., Proc.* **134.** *pp.* 154–170, *Nov.* 3, 1931.—The scattering of α-particles by beryllium, barium, carbon and aluminium has been studied at large angles of scattering and, in part, for α-particles of different velocities. At the largest angles the scattering is much greater than that calculated on the assumption of inverse-square-law forces between the nucleus and the particles, and the discrepancy increases rapidly with increase of the velocity of the particles. The results obtained have, however, been shown to be in accordance, at least qualitatively, with those predicted by wave mechanics. An approximate calculation of the size of the scattering nuclei yields for aluminium $3 - 6 \times 10^{-13}$ cm., and for boron $2 \cdot 4 - 4 \cdot 8 \times 10^{-13}$ cm.; the carbon nucleus is a little larger than that of boron. H. F. G.

HEAT.

1279. Friction, Heat Conduction and Diffusion of Gaseous Mixtures. Part XX. M. Trautz and E. Gabriel. *Ann. d. Physik.* 11. 5. *pp.* 606–610, *Oct.* 27, 1931.—A continuation of previous work [see Abstract 518 (1932)]. The friction constant was measured for pure NO between room-temperature and 250°, and good agreement obtained between experimental and theoretical values. The bilogarithmic T-coefficient m decreased with increase of temperature in the normal manner, and the Sutherland constant was constant at $C = 128$. The value of $M\theta$ is given as 24·8, which is approximately the mean of $O_2(25{\cdot}7)$ and $N_2(22{\cdot}4)$. The value of η between 0° and 350° was calculated and, within the limits of experimental error, the limiting value m_1 of the bilogarithmic temperature coefficient was found to be 0·503. At room-temperature and also at 100° the value of η for three different proportions of N_2/NO mixtures was measured. The η-isotherms are linear and the various factors concerned are deduced and given. S. G. B.

1280. Numerical Evaluation of Infinite Series and Integrals Occurring in Heat Flow, Diffusion, etc. W. L. Miller and A. R. Gordon. *J. Phys. Chem.* 35. *pp.* 2785–2884, *Oct.*, 1931.—The paper is mathematical throughout. It contains in effect methods of transforming the ordinary Fourier series or integrals into others which are in general more rapidly convergent. An appendix contains numerical tables to six or more places, for the function $\exp.(-x^2)\int_0^x \exp. y^2 . dy$ for arguments up to 12; to 10 figures for $G(x)$ and $\int_0^x G(x)dx$ from $x = 0{\cdot}4$ to $2{\cdot}5$, and tables for evaluating Fresnel's integrals without graphical interpolation. Here $G(x)$ is $\int_0^x y^{-\frac{1}{2}} \exp.(-\pi^2/y)dy$. J. H. A.

1281. Theory of Heat Conduction and Diffusion. K. Uller. *Phys. Zeits.* 32. *pp.* 892–897, *Nov.* 15, 1931.—Discusses the possibilities of replacing the equation: Heatflow $= -k \operatorname{grad} v$ by: Heatflow $= -k_0 \operatorname{grad} f(v)$ where k is the conductivity and v the temperature. In the first form, the results of theory have to be brought into line with experiment by assuming k to vary with temperature, whilst in the second case, this could be avoided by suitable choice of the function $f(v)$. The matter is discussed in the light of the conception of temperature waves. Similar remarks apply when k is the coefficient of diffusion and v the concentration. J. H. A.

1282. Thermal Conductivities of the Saturated Hydrocarbons in the Gaseous State. W. B. Mann and B. G. Dickins. *Roy. Soc., Proc.* 134. *pp.* 77–96, *Nov.* 3, 1931.—The object of the research is to investigate the relation between molecular structure and thermal conductivity of the gaseous saturated hydrocarbons. The method adopted is that known as the "hot-wire" method, the theory of which has been given by Gregory and Archer [see Abstract 1059 (1926)]. On plotting the results for methane, ethane, propane and butane, it is found that they can be expressed by the equation $(K_0 - 0\cdot00002227)(M - 5\cdot53) = 0\cdot0005241$, where K_0 is the thermal conductivity at 0° C., and M the molecular weight. The two compounds *n*-pentane and *n*-hexane, whose values were also determined, do not fit the curve quite so well. The temperature coefficients between 4° and 20° C. are also found to be on a smooth curve with a maximum (0·0076) for *iso*-butane. T. B.

1283. Thermal Conductivity of Rare Gases. M. Curie and A. Lepape. *Comptes Rendus*, **193.** *pp.* **842–843,** *Nov.* **9, 1931.** *J. de Physique et le Radium*, **2.** *pp.* **393–397,** *Dec.*, **1931.**—Using a method of thermometric cooling similar to that of Müller, values were obtained for the thermal conductivity K and the constant A in the formula $K = A\eta c_v$ where η is the viscosity and c_v the specific heat of the gas at constant volume. Measurements were made between 20° and 40° with a pressure of 5–10 mm. when convection may be neglected. Values of K_0(0° C.) and A are tabulated for the gases He, Ne, A, Kr and Xe. For He, Ne and A the results for K_0 agree with former values. The values of A for all the gases are near to 2·5, the value which Maxwell obtained by introducing into the dynamics of elastic molecular collisions a force of repulsion with a feeble radius of action of $1/d^n$ where $n \geq 5$. R. S. R.

1284. Rational Unit of Thermal Conductivity. P. Vernotte. *J. de Physique et le Radium*, **2.** *pp.* **376–380,** *Nov.*, **1931.**—The close analogy between thermal and electrical conductivity has led to the choice of a unit of thermal resistance, namely, the " Fourier." This is fully discussed. It is pointed out that " resistance " has only a direct interest if the phenomenon of pure conduction can be observed in a body, an impossibility in the case of heat. Convection accompanies conduction and specific heat effects complicate the issue, so it is necessary to examine each disturbing factor and to introduce corresponding coefficients depending upon the conductivity. The analogy between the two conductivities, thermal and electric, is only superficial. Consider two points. (1) Thermal conductivity, being a function of the temperature, a factor which determines the thermal equilibrium, etc., is quite different from the electrical analogy. (2) The electrical flux multiplied by the resistance represents energy, but the analogous thermal quantity has no physical significance. The question now arises as to the choice between conductivity and thermal resistance. The author suggests that conductivity corresponds better to the conception of thermal flow through a body, and reveals its passage by direct phenomena, and there is less risk of confusion of terms, etc. He discusses the most suitable unit to which to attach a definition of conductivity, *viz.*, the calorie, which is not readily accessible, the joule, which closely associated with modern methods of thermal conductivity assessment, or some new unit. The small precision of modern measurements of heat conductivity gives considerable latitude for the definition for the unit of heat. In conclusion the author suggests that the title " Fourier " be given to the unit of thermal conductivity, the heat being measured in joules. S. G. B.

1285. Thermal Expansion of Aluminium Alloys. E. E. McCollough. *Physics*, **1.** *pp.* **334–339,** *Nov.*, **1931.**—The effect on the thermal expansion of Al of alloying it with different percentages of Cu, Fe, Mg, Ni, Si and Mn was investigated by an interferometer method. The interferometer was an adaptation of that of Souder and Peters. The preparation of the alloys and the method of test were described. It was found that an empirical equation based upon the assumption that the coefficient of thermal expansion of the alloy is the arithmetic mean of the coefficients for Al and the alloying element is limited in its use and holds only over the smooth parts of the curve. R. S. R.

1286. Realisation of the International Scale of High Temperatures. J. Mendousse. *Ann. de Physique*, 16. *pp.* 209–310, *Oct.*, 1931.—The researches here described have for their object the development of experimental methods of measuring temperatures defined by the following equation, which is based on Wien's formula. The equation is, $1/1336 - 1/(t + 273) = (\lambda/1432) \log_e (b_{\lambda t}/b_{\lambda 1063^\circ \mathrm{C.}})$, where $b_{\lambda t}$ is the luminosity of a black body at the legal temperature t for the wave-length λ. This equation was defined by the International Conference in 1927 as the legal scale of temperatures superior to 1063° C. (the melting point of gold). The black body at the point of fusion of gold has been realised by the filament method and also by the " bath " method, the latter consisting in keeping a considerable mass of pure gold for any required length of time at its melting point while observations are being made. The precision of the instruments (spectrophotometers, etc.) used in the measurements has been studied experimentally by means of the luminosities defined by tungsten ribbon lamps and by disappearing filament pyrometers. The lamps and pyrometers have been used, after standardisation with the premier instruments, for actual measurement of temperature, the errors being probably less than 0·1° at 1100° C., and 0·5° at 2700° C. The production, regulation and measurement of the electric currents involved have been the object of special study, and the graduations of the special pyrometers which the work has been able to establish appear to be correct to 0·1° near 1100° C., 0·5° at 1600° C., and 1° at 2500° C. T. B.

1287. Ternary Heteroazeotrope Composed of Carbon Disulphide, Acetone and Water. W. Swietoslawski and (Miss) L. Wajcemblit. *Comptes Rendus*, 193. *pp.* 664–666, *Oct.* 19, 1931.—The method previously described [see Abstract 510 (1932)] has been applied to the system CS_2-acetone-water, a differential ebullioscope being employed to determine the azeotropic constants. The boiling point of the liquid t_b and the condensation temperature t_c of the vapour have been determined for known mixtures of CS_2 and acetone, and the variations of these temperatures on addition of water have been observed. As t_b and t_c fall the difference between these at first increases and then decreases to zero at the temperature at which t_b is a minimum; at this point the composition of the liquid lies on the heteroazeotropic line of the ternary diagram. The heteroazeotropic mixture boils at 38·042° C., and contains 75·21 % of CS_2 and 23·98 % of water; the upper layer forms 1·8 % of the total volume. H. F. G.

1288. Variation in Melting Points of Mineral Oils Accompanying Change of State: " Tempering " of Oils. P. Woog, Émilie Ganster and Fanny Coulon. *Comptes Rendus*, 193. *pp.* 850–852, *Nov.* 9, 1931.—Certain mineral oils, congealed by cooling to − 85°, show different melting points according to the rate of cooling, the time during which the oil is kept at the congealing temperature, and the temperature of the bath in which fusion takes place; the melting point tends to a constant value as the rate of cooling is lessened, and the time of maintenance at the congealing temperature prolonged, *i.e.*, as the oil is more completely "tempered." It is concluded that the oil solidifies in two forms—vitreous of lower, and crystalline of higher, melting point, and that time is required for the conversion of the vitreous into the crystalline form. C. A. S.

1289. Anomalies in the Use of Benzene and Nitrobenzene for Cryoscopic Measurements. (Miss) M. T. François. *Comptes Rendus*, 193. *pp.* 1008–1010, *Nov.* 23, 1931.—The cryoscopic constants of benzene and nitrobenzene have been determined from measurements with solutions of thirteen of the normal fatty acids between acetic and palmitic. Contrary to previous views regarding the anomalous behaviour of these solvents, there is no evidence for the existence of one normal and one abnormal constant; on the other hand, the constants rise continuously from 29·7 and 46·5 for benzene and nitrobenzene, respectively, to 46·3 and 86·2 on passing from acetic to palmitic acid. H. F. G.

1290. Specific Heat in Relation to Raman Effect Data. S. Paramasivan. *Indian Journ. Phys.* 6. *pp.* 413–420, *Nov.* 30, 1931.—The field of Raman spectroscopy provides a mass of rapidly accumulating data regarding the fundamental oscillation frequencies of elements and compounds. In the present paper an attempt is made to correlate them with the specific heat data in some simple substances. Good agreement is found between calculated and observed values. AUTHOR.

1291. Ratio of Specific Heats of Gases by Kundt's Tube Method. A. K. Shaha. *Indian Journ. Phys.* 6. *pp.* 445–451, *Nov.* 30, 1931.—The velocity of sound through gases was measured by observing the wave-length given out by the telephone whose frequency had been determined by the preliminary experiment with dry air. The ratio of the specific heats λ is determined from this by the formula $\lambda = L^2n^2\rho/P$, where L is the wave-length, n frequency, P pressure and ρ the density. The percentage of error on repetition of the same experiment is 0·045. The following are the experimental results:

	°C.	λ.
Acetaldehyde	30	1·145
N-propyl alcohol	110	1·272
Iso-propyl alcohol	110	1·590
Pentane	40·2	1·382
Amylene	43	1·432

AUTHOR.

1292. Chemical Constants of the Vapours of H_2 and of HCl; and the Entropy Change in the Reaction $H_2 + Cl_2 \rightleftarrows 2HCl$. T. E. Stern. *Roy. Soc., Proc.* 133. *pp.* 303–310, *Sept.*, 1, 1931.—Points out an error in the author's previous paper on H_2 vapour [see Abstract 1974 (1931)]. The chemical constant i' of this vapour at very low temperatures is now found, to the order of accuracy involved, to be the same as Fowler's result. The ratio of ortho-hydrogen to para-hydrogen molecules is 3:1 (about), and not 3⅛ : 1 at 17° K., as was previously found. Our knowledge of the energy levels relevant to the evaluation of the partition functions for gaseous HCl molecules is quite complete. It is shown that the differences in the moments of inertia of the HCl^{35} and HCl^{37} molecules can be neglected in calculating the gaseous partition functions. The molecules of the crystal have the same statistical weight in their lowest quantum state as those of the gas. The author is able to calculate the chemical constant of the vapour as $i' = -0{\cdot}42$, in fair agreement with Eucken's old experimental value, and in excellent agreement with the value $-0{\cdot}450$ obtained by Eucken from the experiments of Giauque and Wiebe. A value is obtained for the entropy of crystalline hydrogen chloride at the absolute zero. There is a diminution of entropy in the reaction $H_2 + Cl_2 = 2HCl$ equal to 1·63 cal./° C. A check is made on the constant in the equation for the equilibrium constant. H. N. A.

1293. Definition and Evaluation of the Fugacity of an Element or Compound in the Gaseous State. G. Tunell. *J. Phys. Chem.* **35.** *pp.* **2885–2913**, *Oct.*, **1931.**—The definition of fugacity adopted in this paper, namely, $\mathrm{RT}\,ln f(\mathrm{T},\ \mathrm{P}) = \mathrm{RT}\,ln\mathrm{P} - \int_0^{\mathrm{P}} (\mathrm{RT}/\mathrm{P} - \mathrm{V})d\mathrm{P}$, $\mathrm{O} < \mathrm{T} < \infty$, $\mathrm{O} < \mathrm{P} \leq \phi(\mathrm{T})$, $f(\mathrm{T}, \mathrm{O}) = 0$, $\mathrm{O} < \mathrm{T} < \infty$, or, in the equivalent form, $f(\mathrm{T}, \mathrm{P}) = \mathrm{P}e^{-\frac{1}{\mathrm{RT}}\int_0^{\mathrm{P}} a(\mathrm{T},\, \mathrm{P})d\mathrm{P}}$, $\mathrm{O} < \mathrm{T} < \infty$, $\mathrm{O} \leq \mathrm{P} \leq \phi(\mathrm{T})$, is based on the physical hypothesis (experimental fact) stated by Lewis and Randall that $\lim_{\cdot\mathrm{P}=0}(\mathrm{RT}'/\mathrm{P} - \mathrm{V}) = \mathrm{K}(\mathrm{T}')$, where $\mathrm{K}(\mathrm{T}')$ denotes at a given temperature a constant different from zero except at the Boyle temperature. This equation of definition is an equation that is used in the experimental determination of fugacity, and it has been shown to lead directly and rigorously to the equations that Lewis and Randall write as their definition of fugacity. The definition of this paper indicates that the fugacity has the dimensions of pressure, and the character, stressed by Lewis and Randall, of an " ideal vapour pressure." The fugacity equation of gaseous nitrogen is presented with numerical coefficients based on the constants of Beattie and Bridgeman. H. H. Ho.

1294. Optical Examination of the Collision of Gas Molecules with a Solid Wall. W. R. van Wijk. *K. Akad. Amsterdam, Proc.* **34. 8.** *pp.* **1201–1205, 1931.** *In German.*—Knudsen found that the thermal conductivity of rarefied gases is in general less than would be the case if the gas molecules on collision with the wall of the vessel had possessed the Maxwell distribution of velocity corresponding to the wall temperature. But if a stream of molecules with a Maxwell distribution of velocity of the temperature T_1 strikes a wall of temperature T_w it is possible to define a temperature T_2 to which the conductivity formally corresponds; and a quantity $a = (T_2 - T_1)/(T_w - T_1)$ is known as the " accommodation coefficient " for the exchange of heat considered. The object of the present article is the description of the apparatus used and the results obtained to date in an investigation of the collision of gas molecules with the walls of the vessel by observations of the intensities of lines of the molecular spectrum. A diagram shows the discharge tube consisting of two concentric cylinders of quartz 1 mm. thick; the inner cylinder is water-cooled, and is provided with a rough surface by the electrolytic deposition of platinum black, while the inner wall of the outer cylinder, which is heated by an electric oven, is smooth and 1 mm. distant from the roughened wall of the other cylinder. Nitrogen, which possesses an accommodation coefficient of 0·8 towards glass, is used, and exposed to 20,000 volts; the lowest practicable pressure was 1/50 mm. corresponding to a mean free path of 3·1 mm. Towards the rough wall the coefficient was $a = 1$, and the gas molecules accordingly left it with a distribution of velocity and rotational energy corresponding to the temperature of the wall. Preliminary results indicate that the molecules reflected from the wall possess no Boltzmann distribution of rotational conditions and, indeed, that the high rotations are present in too great a number. This remarkable result is qualitatively independent of the ratio between the molecular densities before and after collision. T. B.

1295. Application of van Laar's Theory to Tungsten and Molybdenum Compounds. J. A. M. van Liempt. *K. Akad. Amsterdam, Proc.* 34. 7. *pp.* 1032–1037, 1931. *In German.*—In the theory referred to, a and b are the constants in van der Waals' equation of state, and van Laar's theory shows that the values of $\sqrt{a}$ and of b for a compound are additively compounded from the values for its constituent elements, except in certain non-polar compounds, such as CCl_4, $SiCl_4$, where the central atom must be neglected. These values are to be taken at corresponding temperatures for the compound and all its constituents. Using data on the fluorides and chlorides, the values of b and of $\sqrt{a}$ at the critical point are calculated for tungsten and molybdenum. J. H. A.

1296. Thermodynamic Properties of Dichlorodifluoromethane, a New Refrigerant. R. M. Buffington and J. Fleischer. *Indust. and Engin. Chem.* 23. *pp.* 1290–1292, *Nov.*, 1931.—The specific heat of dichlorodifluoromethane vapour at atmospheric pressure was measured in a flow calorimeter at 0°, 25·8° and 49·9° C., the experimental data fitting the equation, $C_p(\text{molal}) = 17{\cdot}0 + 0{\cdot}0279t(t^\circ\,\text{C.})$. The heat capacity of the liquid was measured as 30·3 cal. per mole per ° C. at 17° C., using the method of mixtures, and as 25·4 at − 43° C., using an electrical heating method. The latent heat of vaporisation was determined by an electrical heating method as 4880 cal. per mole at the boiling point, − 29·8° C.; 4100 at 23° C.; and 3960 at 28° C. The ratio C_p/C_v for the vapour at 25° C. and atmospheric pressure was determined by the Kundt method as 1·139. [See also Abstract 2738 (1931).] AUTHORS.

1297. Basis of the Second Law of Thermodynamics in Quantum Mechanics. O. Klein. *Zeits. f. Physik*, 72. 11–12. *pp.* 767–775, *Nov.* 16, 1931.—A development of the laws, in statistical quantum mechanics, which correspond to those used by Gibbs in his formulation of the mechanical explanation of thermodynamic irreversibility. The theory is based on the use of the density-matrix introduced by Dirac in the statistical study of assemblies. G. C. McV.

SOUND.

1298. Dispersion of Explosion Waves in the Atmosphere. P. Duckert. *Gerlands Beitr. z. Geophys. Supplementband I. pp.* 236–290, 1931.—The theory of dispersion of longitudinal waves is first given, with various hypotheses, and an account then follows of the investigation of the dispersion of explosive waves by means of systematic explosions. At the moment of detonation a spherical wave starts out with frequency components from 100 to 200, and also from 2 to 8. The zone of audibility is bounded on the outside by a zone of silence; beyond this is another audibility zone, then another zone of silence and so on. The zonal distribution is illustrated by maps. Duckert's calculations give an average speed of sound at 296 m./s. in the stratosphere up to a height of 30 km. The speed then increases rapidly to 360 m./s. for heights up to 40 km. The increase is not uniform, but takes place chiefly in two layers situated respectively 31 and 37·5 km. above the ground. Possible explanations of the increased speed in the upper stratosphere are discussed. A full Bibliography is appended. G. E. A.

1299. Plane Sound Waves of Finite Amplitude. R. D. Fay. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 222–241, *Oct.*, 1931.—The principal object of the analysis is to find the change in type of periodic plane waves of sound of finite amplitude propagated in free air. A solution of the exact equation of motion is obtained as a Fourier series. Owing to the non-linear relation between pressure and specific volume there is a gradual transfer of energy from components of lower frequency to those of higher frequency. Since higher frequencies are attenuated more than lower by viscosity effects there is always a stable wave form such that the decrease in relative magnitude of any component due to viscosity is compensated by the relative increase due to non-linearity. The stability conditions vary with intensity. There is no permanent wave form, but the stable wave will change its form more gradually than any other of the same intensity and wave-length. The change of type of any wave is towards this stable form. There is a marked departure from the sinusoidal in the stable type even for waves of very moderate amplitude. A. W.

1300. Propagation of Air Waves in a Long Pipe. T. Vautier, R. de la Boulaye and G. Balme. *Ann. de Physique,* 16. *pp.* 311–410, *Nov.*, 1931.—In this third paper the account of the research on the passage of air waves along a wide tube is completed. One end of the tube is closed and the other end is open, and the speed, amplitude and other data are measured for the cases in which the wave is produced (*a*) at the closed end and (*b*) at the open end. The speed for musical sounds in air at 0° C. is estimated at 330·79 m./s. As before, the paper is illustrated with diagrams of the pressure waves as they pass and repass along the tube. [See Abstract 1328 (1931).] G. E. A.

1301. Relation between Sound Perception and Sound Excitation, and its Influence on the Audibility of Distorted Sounds. W. Janovsky. *Zeits. f. techn. Physik,* 12. 12. *pp.* 611–621, 1931.—A normal or unit sound is defined as that due to a progressive plane wave of sine form of frequency 1000 which approaches the observer's head from the front, one ear being closed. If the pressure of the normal sound is P, the loudness L is given by 20 log P/P_0, where $P_0 = \sqrt{10}/10^4$ dynes/cm^2., the threshold pressure. A sound pressure of 1 dyne/cm^2. corresponds to a loudness of 70 phons. When 20 log P is graphed with L, using Kingsbury's numbers [see Abstract 2342 (1927)] straight lines result which vary somewhat in slope with the frequency. The loudness at any frequency f is given by $L = C \log P/P_0$, where $C = 19{\cdot}9 + 10(3{\cdot}1 - \log f)^2$. Knudsen's measurements of the minimum audible increase in loudness bring out that, as the sound pressure increases, the minimum diminishes to become practically constant at higher pressures. With weak sounds a difference of 1 phon is less easily heard than with louder sounds, but 1 phon may be regarded as the average smallest audible difference in loudness. Also discussed are fatigue of the ear and screening effect. The latter is greatest in the immediate neighbourhood of the screening tone frequency. The effects of ear sensitivity and other factors on the audibility of distorted tones are described. G. E. A.

1302. Acoustic Insulation and the Cancellation Effect at the Basilar Membrane. A. G. Pohlman. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 269–274, *Oct.*, 1931.—The paper opens with a functional comparison between the eye and the ear, and the question is suggested as to whether there is an acoustic insulation, comparable to a light-proofing of the eye, which places the end organ of audition under conditions of physiological quiet. The following are among the author's conclusions. The auditory end organ, because of its immersion in the cochlear liquid, is insulated by a factor of about 40 db. The middle apparatus has the function of an impedance-matching transformer, and may be likened to a closed-back telephone transmitter. If the cochlear liquid is not regarded as incompressible, the pressure applied simultaneously to the two sides of the basilar membrane tends to cancel out its vibrational responses. The internal ear may accordingly be likened to an open-back telephone transmitter, and may therefore be considered as provided with acoustic insulation and automatic intensity control. G. E. A.

1303. Differential Pitch Sensitivity of the Ear. E. G. Shower and R. Biddulph. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 275–287, *Oct.*, 1931.—Differential pitch sensitivity is the minimum change in frequency which is detectable at any one frequency and sensation level. The frequency range covered is from 31 to 11,700 at sensation levels from 5 db above the threshold to the maximum which the observer could tolerate. The frequency change was made by a special rotary condenser, and the change was made at what was found to be the optimum rate of twice per second. Graphs show that for sensation levels varying from 5 to 60 db, $\Delta f/f$ diminishes as the frequency f increases, a flat minimum being reached at frequencies above 500. When the frequency is the parameter, $\Delta f/f$ diminishes, as the sensation level increases, to a value which is constant from 20 db, or upwards, depending on the frequency. At a frequency about 45, the graph of $\Delta f/f$ with f has a point of inflection which is ascribed to the presence of subjective harmonics, and it is supposed that, at very low frequencies, pitch variation is detected by means of the variations of the subjective harmonics. When the tone is heard binaurally, the minimum detectable frequency change is further reduced; this holds also when the tones are heard by bone conduction. [See also Abstract 2229 (1923).] G. E. A.

1304. Reverberation Time Measurements in Coupled Rooms. C. F. Eyring. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 181–206, *Oct.*, 1931.—Expressions are developed for the sound energy-densities in two coupled rooms at any time, and these are tested by measurements for the following cases, a small " live " room coupled by varying portions of its surface to a large dead room; then to a large moderately live room. In the third case a large dead room is coupled to a large live room by means of a small room, and in the fourth case one portion of a room is live and the other part is dead. It is found that a window which opens into the out-of-doors or its equivalent cannot be considered to have an absorption coefficient of unity. The cause of the apparent lowering of the coefficient is reflection at the opening, and also the lack of a diffuse state of the sound waves due to the presence of the highly absorbing opening. Unless an opening has dimensions large compared with the wave-length of the tone used, and an area small compared with the surface in which it is located, a correction factor will be required. The theoretical equations of decay are found adequate to describe the experimental results. As a final illustration it is shown how the equations may be applied to the case of an ideal theatre with a small balcony. G. E. A.

1305. Regulating the Acoustics of Large Rooms. E. Petzold. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 288–291, *Oct.*, 1931.—The author suggests the use of acoustical controllers in the form of columns of triangular section. These are placed vertically in front of the walls, their sides are composed respectively of good reflectors, good absorbers and good resonators, *e.g.*, plaster, celotex and wood, and the columns can rotate about their axes. The columns can thus be set so as to reflect, absorb or resonate as required, and various combinations are suggested to suit the different conditions met with in concert halls, theatres, churches, lecture rooms and studios. G. E. A.

1306. Ultrasonic Waves and Properties of Inaudible Sound. F. L. Hopwood. *Nature*, 128. *pp.* 748–751, *Oct.* 31, 1931.—With a quartz disc 7 cm. in diameter and 5 mm. thick, in conjunction with a 3 kW valve oscillator, ultrasonic waves were produced by which reflection and refraction effects could be demonstrated. An application of the waves was made in the study of architectural acoustics, and the whispering-gallery effect was shown by means of a model of the lecture theatre of the Royal Institution. The pressure of the waves caused rotation of the vane of a torsion pendulum, and it is suggested that the effect may be employed to measure sound intensities and transmission and reflection coefficients of materials. When the beam is directed to a mass of liquid acoustic distillation takes place; it also liberates bubbles of dissolved air from water, but not if the acoustic intensity is very high. The last part of the paper deals with the biological effects of the waves. G. E. A.

1307. Heating of Liquids by the Absorption of Sound, and its Relation to the Energy of Intense High-Frequency Sound Waves. W. T. Richards. *Nat. Acad. Sci., Proc.* 17. *pp.* 611–616, *Nov.*, 1931.—A liquid subjected to h.f. sound waves may be heated not only by absorption of sound by the liquid, but also by absorption by the containing vessel, conduction from the oil round the crystal, and chiefly by dielectric loss in the liquid. An apparatus is illustrated which is designed to eliminate or control these sources of error, and the heating of water and solutions is measured quantitatively. The estimation of the intensity of the source was made by means of a calorimetric method in which a totally absorbing solid plug was substituted for the liquid. The sound energy output of the Wood and Loomis apparatus varied from 17·6 cal./min./cm^2. for an input of 1·3 kW to 152 cal./min./cm^2. for an input of 2·5 kW. G. E. A.

1308. Balance Method of Measuring Sound Transmission. A. E. Knowler. *Phil. Mag.* 12. *pp.* 1039–1042, *Nov.*, 1931.—Describes a method of measuring the sound transmission through a partition, without the inconvenience of having to reduce the sound to threshold intensity. In this method the partition separates two reverberant rooms, each containing a moving-coil loud-speaker. The observer, in one of the two rooms, reduces the intensity of his loud-speaker by means of a shunt, until the intensity matches that of the other loud-speaker, heard through the partition. Observations are then repeated from the other room, the presence of the observer being compensated for by introducing absorbent material. Results are given for a number of materials, and discussed in relation to their density. [See also Abstract 567 (1931).] J. H. A.

1309. Phonometry. A. Bernini. *N. Cimento,* 8. *pp.* 321–330, *Nov.,* 1931.—Points out the want of consistency in the present ways of measuring sound intensity, and describes an electrophonometer, in which a sound is heard through a headphone attached to one ear, adjusted to the proper intensity by means of a variable resistance, and compared with a standard sound of adjustable pitch furnished by a neon lamp and an amplifier. An accuracy within 10 % is all that is aimed at. E. E. F. d'A.

1310. Sound Analysis of a Japanese Hanging Fire-Bell. I. Aoki. *Kyoto Coll. Sci., Mem.* 14. *pp.* 213–218, *Sept.,* 1931.—The present paper describes the experimental investigation of the tone colour of a small Japanese hanging bell. The sounds were recorded by a Low-Hilger audiometer, and the curves obtained were analysed by the method of periodogram-analysis. Generally speaking, the sound of the bell used in the experiment contains about five partial tones, and the ratios of their amplitudes change as the time passes after it is struck. AUTHOR.

1311. Theory of Supersonic Interferometers. W. D. Hershberger. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 263–268, *Oct.,* 1931.—The theory of the supersonic interferometer is developed by deriving an expression for the impedance of the mechanical system to which the instrument may be reduced. The impedance is found to be a function of the crystal constants, frequency, length of fluid column, acoustic resistance of the medium and sound absorption in it. The principal features of the behaviour of the device are thereby explained and its possible usefulness in the measurement of sound absorption coefficients pointed out. AUTHOR.

1312. Vibration of the Violin Body. Part II. H. Backhaus. *Zeits. f. Physik,* 72. 3–4. *pp.* 218–225, *Oct.* 14, 1931.—With the aid of the electrical apparatus described in the first paper [see Abstract 3502 (1930)] the nodal lines on back and front of a Stradivarius violin were investigated over a frequency range from about 200–3000 $\sim$. The results which are shown in numerous pairs of diagrams agree with those of the first paper. W. H. GE.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

1313. Free Electrical Charges on Droplets of Insoluble Liquids in Water. R. Dubois and A. H. Roberts. *J. Phys. Chem.* 35. *pp.* 3070–3081, *Oct.*, 1931.—The free electrical charge on droplets of stearic and oleic acids, tetradecane and tetrahydronaphthalene suspended in water or in dilute solutions of potassium chloride has been measured by the null-point method of McBain and Williams. The charge increases in presence of potassium chloride, and measurement of the conductivity of the solution shows that the electrolyte is adsorbed on the surface of the droplets. The charge per sq. cm. on a fatty acid-water interface is only 10^{-5} that of the charge possible on a surface completely covered with ions of the fatty acid. The hydrocarbon droplets carry practically the same charges as those of the fatty acids. The density of the surface charge on the droplets increases rapidly as the radius of the droplet diminishes. Droplets of water suspended in a liquid hydrocarbon do not move in an electric field, as the effect of the surface charge produced by the adsorbed ions is nullified by the free ions within the droplet. Measurements of the velocity in a horizontal field agree closely with those obtained by the null-point method. H. F. G.

1314. Significance of the Differences between the Dipole Moments of Saturated and Unsaturated Substances. L. E. Sutton. *Roy. Soc., Proc.* 133. *pp.* 668–695, *Oct.* 1, 1931.—Analysis of available data supplemented by measurements of the dipole moments of ortho- and meta-nitrobenzonitriles, benzyl chloride, benzal chloride and methyl chloroform show that there is an " electron shift " which is towards the benzene ring (positive) when the group substituted is ortho-para directing, and away from the ring (negative) when it is meta directing. In the chlorinated toluenes the shift changes from positive in benzyl chloride to negative in benzotrichloride. These effects occur independently of the polarisation caused by the group dipole and appear to correspond with the electromeric effect postulated in Lapworth's and Robinson's theories of activation in conjugated systems. The mean effect is comparatively small, and it is more probable that there is a small effect in each molecule than that there is a large effect in only a fraction of the molecules. Similar effects occur in unsaturated open chain compounds and, from the available evidence, it appears that they are greater than those in the aromatic compounds if the double bonds are conjugated. H. H. Ho.

1315. Measurement of the Dielectric Constants and Molecular Polarisations of Binary Liquid Mixtures. W. Graffunder and E. Heymann. *Zeits. f. Physik*, 72. 11–12. *pp.* 744–762, *Nov.* 16, 1931.—Measurements have been made with a number of binary mixtures, consisting principally of two polar compounds such as acetone, alcohol and nitrobenzene, and at a wave-length of 450 m. The molecular polarisation curves are in general no more complicated than those obtained with mixtures containing only 1 polar component; for most mixtures the curves are linear, but for chloroform—acetone and chloroform—alcohol mixtures the curves deviate considerably from the linear type. The form of the curves is discussed, especially in relation to the question of association. H. F. G.

1316. Spectral Distribution of the Change in the Dielectric Constant Produced by Light in Thin Layers of ZnSCu-Phosphors. E. Breunig. *Ann. d. Physik,* 11. 7. *pp.* 863–884, *Nov.* 23, 1931.—The spectral distribution of the increase in the dielectric constant appears (for thin layers) to be connected with the distribution of excitation in the phosphor, and depends on the number of excited centres. The spectral position for the maximum of the dielectric constant effect is found to be independent of the variation of metallic content in the ZnSCu-phosphor, but is related to the process of illumination in contrast to the rectilinear course of the short-wave extinction effect. The reduction of the rise in the dielectric constant brought about by red illumination provides a further confirmation that the mechanism of the dielectric constant effect cannot be brought into relationship with short-wave extinction. The dependence of the red effect on the wave-length of the exciting light shows that the degradation effect is dependent on the number of activated centres. H. H. Ho.

1317. Charged and Uncharged Nuclei in the Air. J. Scholz. *Zeits. f. Instrumentenk.* 51. *pp.* 505–522, *Oct.,* 1931.—An apparatus is described which can determine the total number and, by means of a cylinder condenser, the number of the uncharged condensation nuclei. The difference of these two numbers gives the number of the charged nuclei. Further, it is possible to obtain, by means of a plate condenser in the apparatus, the charge of one nucleus. This method does not yet give exact results, but further investigations are being carried out. The region of measurement or the limits of number of nuclei between which the number of nuclei existing in the atmosphere can be determined is with this apparatus considerably greater than with Aitken's counter. A minimum of 7 and a maximum of 1,660,000 per c.c. can be determined. It was established that the number of falling drops in the receiver on dilatation was inversely proportional to their size. It was also found that in the receiver self-established dissipation of nuclei takes place, *i.e.,* originally unpurified air in the receiver contains after a time (without the occurrence of dilatation) no more nuclei. A comparison was made in Graz in the air of a cellar between the number of the charged nuclei measured by the nuclei counter and the number of the heavy ions found by the Israel condenser and they were found to be identical. A comparison between the number of the uncharged nuclei and the total number of nuclei gave 0·5 as the ratio. In Potsdam a series of measurements of the relation between the uncharged and the charged nuclei in free air was carried out, and the numbers obtained varied between 1·58 and 6·40. J. J. S.

1318. Deformation and Breaking of Water Drops in Strong Electric Fields. W. A. Macky. *Roy. Soc., Proc.* 133. *pp.* 565–587, *Oct.* 1, 1931.—Drops of water of radius (r) 0·085–0·26 cm., exposed to an increasing electric field, horizontal or vertical, first become elongated (for this in the case of the largest drops a field of at least 5000 V/cm. is required), and when the field strength rises to $3875/\sqrt{r}$ V/cm., unstable. A filament then forms at each end, much larger at the positive, and a discharge passes, a glow or spark being visible in the dark, the luminous effects being such as are characteristic of positive or negative point discharges; the current first passing is of the order of 20 microamperes. When the discharge passes small drops pass away from the filament, thus reducing the size of the drops. In this way the maximum size of drops in a thunderstorm would be limited, as *e.g.*, no drop of $r > 0{\cdot}15$ cm. can persist in a field of 9800 V/cm. Reduction of pressure, unless near such as causes a spark to pass in absence of a drop, has no effect. [See Abstract 4070 (1930).] C. A. S.

1319. Ascending Lightning Flashes. E. Mathias. *Comptes Rendus*, 193. *pp*. 909–912, *Nov*. 16, 1931.—Reference is made to evidence in support of Simpson's theory of the branching electric discharge between cloud and earth or between two cloud layers. (1) Joule gives notes of an observation of such a discharge in which time was occupied in forming the branches. (2) Liais supplies notes of an ascending flash from a small cumulus cloud, and of a descending flash from an upper cloud layer, the duration of development of the branches indicating flow in a resisting medium. The author suggests that the travelling end of the branching flash should be spherical or approximately so. R. S. R.

1320. Structure of Ultra-Radiation. Part II. Comparative Measurements with Two High-Pressure Ionisation Chambers. W. S. Pforte. *Zeits. f. Physik*, 72. 7–8. *pp*. 511–527, *Oct*. 28, 1931.—The two chambers had a common compensation arrangement. They were first placed side by side (cylinders vertical), when very little agreement was found between their variations. They were then placed close together, in the horizontal position, one above the other, when there was a strong correlation between the variations. The effect of the alteration of the air pressure was taken into consideration. The variations are found to follow the statistical laws. The solar time has an influence, though a slight one, on the readings; but so far no influence of the sidereal time has been observed. [For Part I, see Abstract 890 (1931).] H. N. A.

1321. Statistical Oscillations in the Specific Radiation in Radiation Apparatus. W. M. H. Schulze. *Phys. Zeits*. 32. *pp*. 808–810, *Oct*. 15, 1931.—In accurate investigations of the ultra-radiation high demands are made on the constancy of the conditions of experiment and on the characteristics of the instruments used. Amongst the latter the so-called characteristic radiation or residual radiation of the radiation apparatus introduces a factor of uncertainty, and also the difficulty of completely screening off all foreign radiation. The origin of the residual radiation lies chiefly in radioactive impurities in the walls of the containing vessel or in a characteristic activity in the metal investigated. In this paper on the basis of the statistical laws found to apply in radioactive processes it is sought to establish whether and in what degree the intensity of characteristic radiations experiences oscillations. If it is assumed that the residual ionisation depends only on a characteristic or specific activity in the zinc used, then the mean relative oscillation would amount to only about 1/10th or 1/20th of the values worked out by the author on the assumption of a decay constant of 10^{-22} to 10^{-23} sec.$^{-1}$. For the explanation of the ionisation oscillations this allows the inference of considerable changes in ultra-radiation, which, according to the observations with the Hoffmann-Steinke apparatus, are not probable. J. J. S.

1322. Residual Ionisation in Nitrogen at High Pressures. J. W. Broxon. *Phys. Rev.* 38. *pp.* 1704–1708, *Nov.* 1, 1931.—The residual ionisation in nitrogen at high pressures was measured under conditions existing during a recent investigation of the residual ionisation in air [see Abstract 3514 (1931)] with lead and water shields. As in earlier investigations, the residual ionisation in nitrogen was found to be greater than that in air at all pressures. However, at the new high pressures the ionisation-pressure curve becomes parallel to the pressure axis, as do the air curves. The explanation in terms of subsidiary radiations excited by the cosmic penetrating radiation in the walls of the ionisation chamber serves as well for nitrogen as for air. The new work is discussed in relation to earlier investigations of the residual ionisation in air, oxygen, nitrogen and carbon dioxide. AUTHOR.

1323. Specific Ionisation of High - Altitude Radiation. W. Kolhörster and L. Tuwim. *Zeits. f. Physik*, 73. 1–2. *pp.* 130–136, *Nov.* 24, 1931.—Tuwim's theory of the vertical counter tube effect for high-altitude radiation contains a constant N_0, which is analogous to the constant J_0 in the formula $J = J_0 V\Phi(\mu H)$, which holds for ionisation chambers. It is shown that the specific ionisation of this radiation is $k = J_0/N_0$. Experimental values of J_0 and N_0 give $k = 135$ ions cm.$^{-1}$ or three times greater than with the swiftest radioactive β-rays. The value of k gives a lower limit for the energy of the single high-altitude ray equal to 2×10^9 e. volts. This calculation is independent of any hypothetical assumptions as to the nature or absorption mechanism of the radiation. H. N. A.

1324. Absorption of Ions by Spherical Conducting Particles in an Ionised Field. M. Pauthenier and Mme. Moreau-Hanot. *Comptes Rendus*, 193. *pp.* 1068–1070, *Nov.* 30, 1931.—A theoretical study is made of the charge and movement taken by a spherical conducting particle of a few to 100 microns radius in an ionised field of known intensity, and of the experimental control of the results of calculation. A summary is given of the results obtained on similar problems by Rohmann and Deutsch. Diagrams illustrate the results of the theory for charges of 10^4e, 3×10^4e and $3 \cdot 8 \times 10^4e$ in the region where the radial field changes sign, including the case where the critical state is just exceeded. The eventual rôle of Brownian movement is then rapidly limited in the case of large particles. These considerations form the basis of the dynamics of the large ions in the ionised space. R. S. R.

1325. Problem of the Aurora. C. Störmer. *Gerlands Beitr. z. Geophys., Supplementband I, pp.* 1–86, 1931.—The author first reviews the various forms taken by the aurora, as shown by a large number of typical plates, its height above the earth's surface, the illumination of auroral rays by the sun and the differences shown by rays so illuminated and those in the earth's shadow, and the effects of solar radiation and ultra-violet light on penetrating corpuscular radiation. Many associated problems and remarkable auroral forms are discussed and their possible causes, while the auroral spectrum is examined in detail. A mathematical analysis is next made of the corpuscular theory and the complete paths of electric corpuscles in the magnetic field of a dipole considered. The results are applied to special types of paths and to the explanation of variations in the draperies, rays, etc., of the aurora. Other related problems such as magnetisation of the sun, structure of the solar corona, gravitation, radiation pressure, Eschenhagen waves and short-wave echoes and their effects on the corpuscular stream and magnetic storms and perturbations are examined. R. S. R.

1326. Synthesis of the Aurora. A. Dauvillier. *Comptes Rendus*, 193. *pp.* 946–948, *Nov.* 16, 1931.—To illustrate the Nordenskjöld polar aurora the author constructed a model consisting of an Al sphere coated externally to be luminescent and having lines of latitude and longitude marked on it. A thin Fe sphere is enclosed with its magnetic axis inclined at 15° to that of the axis of rotation. A kathode beam is directed to the pole and the electrons when approaching the pole are deviated in two opposed directions. Under favourable circumstances three spirals corresponding to the multiple coronæ of Nordenskjöld are found. This explains the greater area of the corona in summer than in winter, the very variable ellipticity and its increase with the speed of the electrons, the opposed variations in frequency at high and low latitudes, and the increase of solar electrons with latitude. The rotation of the electronic spirals around the globe occurs at a distance equal to the earth's diameter. It is possible to explain in this way the Paris declination curve, the displacement of the auroral arc with reference to the magnetic meridian and the annual frequency curves of the aurora at high and low latitudes. The cause of the known rapid fluctuations of auroral intensity are also discussed and their possible explanation on this theory. [See Abstract 187 (1932).] R. S. R.

1327. Emission Bands of the Polar Aurora in the Spectrum of the Night Sky. J. Dufay. *Comptes Rendus*, 193. *pp.* 1106–1108, *Nov.* 30, 1931.—Photographs were made of the western night sky spectrum at Lyons with a new spectrograph having two flint prisms and wide aperture for exposures of 22, 85 and 54 hours in Sept., Oct. and Nov., 1931, at elevations of 14° to 21°. A large number of bands or emission rays were found and the results tabulated and compared with those obtained by Sommer, Végard and Kayser. The wave-lengths are determined to a few Å.; all are feebler than the line 5577 Å.; some are found also in the aurora and some auroral lines are not found. The bands 4707 and 3914 Å. belong to the negative group of nitrogen and 4269 is the most intense of the second positive group, while 4142 probably also belongs to the latter. Other lines are not identified, but Vegard attributes some to atomic rays of nitrogen. A second apparatus, exposed simultaneously, but for shorter durations, shows that the bands are frequently present if not permanent, and these explain the great intensity of the blue and violet radiation of the sky. R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

1328. Theory of Electronic Semi-Conductors. Part I. A. H. Wilson. *Roy. Soc., Proc.* 133. *pp.* 458–491, *Oct.* 1, 1931.—To obtain a model of an insulator or semi-conductor to which the quantum theory may be applied it is necessary to have a perfect lattice, in which all the electrons are free, and in which there are no conduction electrons at the absolute zero. This is not possible using Sommerfeld's picture of electrons moving in a region of uniform potential; but actually in a lattice the potential in which the electrons move is periodic in three dimensions. The problem has already been dealt with in one dimension by several authors, and it appears that the energy levels break up into a number of bands of allowed energies, separated by bands of disallowed energies, which may be of considerable width. The author shows that the same holds for a certain form of three-dimensional model, and that if in it the number of electrons is just sufficient to fill up the lowest band of allowed energies, when all the electrons are in their lowest possible state, there will be no current at absolute zero if the field is not large enough to raise the electrons to the next higher band of energies. When the temperature differs from zero there will be a few electrons in the second band, and a few vacant places in the first, and conduction will commence, increasing at first owing to the increase in the number of conduction electrons, but diminishing as the temperature rises, owing to the increased thermal vibrations of the lattice. The calculations are rough, but it appears that a place can be found in the theory for insulators and semi-conductors. H. N. A.

1329. Theory of Electronic Semi-Conductors. Part II. A. H. Wilson. *Roy. Soc., Proc.* 134. *pp.* 277–287, *Nov.* 3, 1931.—Only substances, like cuprous oxide, which always show a negative temperature coefficient, and which become much worse conductors when the amount of impurity is reduced, are now considered by the author as semi-conductors. Here energy band 1 is just filled up with electrons. The foreign atom has a discrete energy level AB, which is normally occupied by an electron, and which lies between bands 1 and 2 of the pure lattice. The foreign atom retains its electron at absolute zero, and the whole substance will be non-conducting. At higher temperatures, owing to the thermal vibrations, the electron in the state AB may jump to band 2 in a neighbouring atom of the pure substance, when it is able to act as a free electron, rendering the substance a semi-conductor. The theory is worked out in detail for metals and for semi-conductors, and the results are tested by means of the experimental work of Vogt on the conductivity and Hall coefficient of cuprous oxide. It appears that the experiments do not contradict the theory, but the assumptions made by Vogt are also adequate to explain the known facts. H. N. A.

1330. Semi-Conducting Cells of Lead Chloride. G. Déchène. *Comptes Rendus*, 193. *pp.* 922–925, *Nov.* 16, 1931.—In a cell consisting of compressed lead chloride, if v_a, v_c be the discontinuities of potential at the anode and kathode respectively, and a the conductivity of the lead chloride, if the cell be new or have been long at rest, a at first diminishes; it increases rapidly with temperature, but decreases as compression is greater; v_a and v_c are independent of current direction, and of the material of the electrodes, but vary with the nature of the surfaces thereof, and with a; the discontinuity at either electrode increases if the area of contact thereof with the lead chloride decreases, or compression thereof increases; it also decreases if the temperature rises. Results are given of tests on the intensity of radiations from these cells under potentials up to 10,000 volts. C. A. S.

1331. Passage of Electricity through Fine Metallic Filaments. W. Kleen. *Ann. d. Physik*, 11. 5. *pp.* 579–605, *Oct.* 27, 1931.—The phenomenon of short-circuit sparks and the consequent fusion of the wire are well known. The present work calls these occurrences electrical explosions to distinguish them from chemical explosions. The investigation of these sparks is carried out systematically in the present paper, and the exact nature of the procedure is observed carefully. Experimental details and numerous plates of actual photographic records are given. From these records the following conclusions can be drawn as to the succession of events in the fusion of a wire due to a short-circuit. The phenomenon is investigated at increasing potentials, and it is established that for increasing energy four stages of explosion are evident. Two stages, namely the point forming process of the light phenomenon and the formation of a layer of vaporised metal, are clearly due to a deformation of the molten wire. This is clearly shown by photographing the phenomenon with a rotating mirror arrangement. The deformation of the molten wire is a capillary phenomenon, the surface tension of the fluid metallic cylinder building up a conformation known as an unduloid. The dimensions of the unduloid are only slightly dependent on the metal, but are proportional to the original diameter of the wire. The constant for Cu, Ni, Ag, etc., lies between 2·3 and 2·7, and results in agreement with Plateau but differs from the theoretical value of Beers. The unduloid is a surface of constant average curvature. Experiment and theory lead to concordant results in this case. Finally, it is shown that the disintegrated metallic particles expelled by the explosion are all electrically charged. S. G. B.

1332. Effect of Potential Difference on Acetone and Ether. J. Sambussy. *Comptes Rendus*, **193.** *pp.* **855–856,** *Nov.* **9, 1931.**—The limiting current through a column of acetone follows Ohm's law accurately. The régime of the depolarisation current indicates electrolytic depolarisation, probably due to a trace of water. The potential falls linearly within the liquid, the drops of potential at the electrodes being comparatively small. Ether behaves similarly unless absolutely dry, when its behaviour is that of a semi-conducting substance, the potential drops occurring almost entirely at the electrodes, *e.g.*, of a total drop of 1440 volts, 320 occurred at the anode, 1000 at the kathode. [See Abstract 2392 (1931).]
C. A. S.

1333. D.C. Conductivity of Acetone. H. Garrigue. *Comptes Rendus*, **193.** *pp.* **925–926,** *Nov.* **16, 1931.**—Further examination of the current through various samples of acetone and nitrobenzene shows that variations are due to irregular distribution of potential, and this to irregularly distributed changes in chemical composition, which are very little affected by light or change of temperature [see Abstract 2392 (1931)]. Assuming change in current due to progressive purification $\log (I - I_0) - \log I$ should be a linear function of the time; this holds well for nitrobenzene, in many cases for acetone, and occasionally for benzene. [See also Abstract 3901 (1930).] C. A. S.

1334. Conductivity Measurements on Powders. P. Guillery. *Phys. Zeits.* **32.** *pp.* **891–892,** *Nov.* **15, 1931.**—The method is designed to measure the true electrical conductivity of a material in powder form, and is based on the change of damping with frequency when a semi-conductor is dispersed in small quantities in a homogeneous dielectric, and an alternating field applied. In the region concerned the apparent dielectric constant decreases regularly with increasing frequency, and the conductivity required may be calculated from the frequency for maximum damping, together with the true dielectric constants of the dielectric and the powder. In the experiments described, frequencies from 2×10^4 to

10^7 hertz were used, and it was found that for Cu_2O, AgCl, AgBr and KNO_3 the true conductivity is practically the same as that obtained by ordinary resistance measurements on the compressed material. For SnO_2, CSi and CuO the result by the latter method is incorrect by a factor of 100 or more. It is suggested that the true conductivity may depend on the particle size in the powder. J. H. A.

1335. Vacuum Thermocouples. J. Jaffray. *Comptes Rendus*, 193. *pp.* 926–927, *Nov.* 16, 1931, *and* 194. *pp.* 451–452, *Feb.* 1, 1932.—The relation between Δ, the scale deviation of a Moll galvanometer, and I, the intensity of current traversing the heating resistance of a vacuum thermocouple for measuring a feeble a.c., provided that the external temperature is constant, is $\Delta = KI^n$. For an old (at 15°) and new (at 22°) model thermocouple K is respectively 0·06318 and 0·07478, n 2·006 and 1·962. If the galvanometer is at a fixed temperature, while that of the thermocouple rises (*e.g.*, from 0°–40°), Δ decreases linearly. When the two instruments are at different temperatures only K varies, n being almost independent of temperature. C. A. S.

1336. Application of Metal Rectifiers in Audio-Frequency Current Measurements. W. Wolman and H. Kaden. *Zeits. f. techn. Physik*, 12. 10. *pp.* 470–482, 1931.—A brief account is given of various arrangements, using one or more metal rectifiers, for measurement purposes and their operation discussed and explained. The non-linear reaction of the rectifiers on the external circuit is explained in a simple manner, and other properties, such as the dependence on frequency and the amount of frequency pulling in potential and current measurements, discussed. It is shown that the dependence on temperature can be compensated by the simple means of introducing a suitable resistance in front of the rectifier. In the quadratic region of the detector characteristic, where the amplitude is small, the effective value of the applied alternating potential is measured. Beyond this region the characteristic approximates to an exponential function which may be used to estimate the departure from the effective value indications for larger amplitudes. The sensitivity can readily be increased by the use of valve amplifiers, and examples of this are given in the latter part of the paper, which describes a number of instruments suitable for use at sonic frequencies. These include current and potential meters for frequencies between 30 and 10,000 ∼, multi-range voltmeters, instruments for measurement of damping, a.c. ohmmeters, and instruments for measurement of sound pressure, noise, etc.
A. W.

1337. Metallic Contacts with Very Thin Foreign Layers. R. Holm. *Zeits. f. techn. Physik*, 12. 12. *pp.* 663–665, 1931.—This is a preliminary paper giving the results of experiments on contacts between metallic surfaces. Thin foreign skins form quickly in air on ordinary metals (not noble). They remove the metallic adhesion but change only slightly the electric resistance of the contact at room-temperature. Their conduction is of a special kind: it changes but little with falling temperature, until it eventually, as in the case of Sn, passes over into superconduction. J. J. S.

1338. Oscillatory Discharge-Figures on Photographic Plates. T. Terada. *Kyoto Coll. Sci., Mem.* 14. *pp.* 219–225, *Sept.*, 1931.—Certain strange discharge-figures are impressed on photographic plates when oscillatory discharges, first negative and then positive, take place at an electrode placed on the plates. The figures thus taken at low air pressures have a strikingly different structure from the ordinary ones obtained with a single discharge, but they are very like those showing the " reversal-like phenomena " which are produced by fogging the photographic plates with a spark simultaneously with the impression of the discharge-figures. An explanation of these strange oscillatory discharge-figures is given on the same lines as that of the " reversal-like phenomenon." AUTHOR.

1339. Modified Form of Discharge Tube for Lichtenberg Figures. T. T. Kung. *Tsing Hua Univ., Sci. Reports*, 1. *pp.* 103–110, *Oct.*, 1931. *In English.*—The discharge tube used to investigate the variation of Lichtenberg figures with pressure consisted of a tube of large diameter with central electrodes reaching to the faces of a plate of insulating material extending across the tube. The effects obtained as the pressure was gradually reduced are described and illustrated. A. W.

1340. Grids in the Kathode Dark Space. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 72. 1–2. *pp.* 1–7, *Oct.* 5, 1931.—If a net grid extending completely across the area of the discharge is introduced into the dark space of a glow discharge, then the current density of the glow discharge is the more reduced, and the width of the dark space increased the closer the grid is brought to the kathode. With constant distances for the electrodes, if the potential of the grid is varied continuously from that of the kathode to that of the anode, keeping the kathode fall of potential constant, the discharge current rises to a sharply defined maximum, which probably occurs when the grid has the potential corresponding to its position in the dark space, and then decreases down to zero when the grid potential equals the anode potential. With constant potential between the grid and anode, increase of the potential between grid and kathode causes a large but gradual increase of current, but with constant potential between grid and kathode increase of the potential between grid and anode causes a rapid increase of current, as in the case of the ordinary glow discharge. From these results it appears that the field in the dark space near the glow has far more effect on the current than the field in the neighbourhood of the kathode. A. W.

1341. Net Grid as Kathode of a Glow Discharge. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 72. 1–2. *pp.* 8–27, *Oct.* 5, 1931.—The glow discharges obtained when using a nickel net grid as kathode extending completely across the discharge were compared with those obtained using a massive iron kathode in the rare gases and also in H_2, N_2 and O_2. With the nickel grid the discharge was in some cases on one side only of the grid and in others on both sides. For the one-sided discharge, in the case of the rare gases, the current for small kathode falls was less for the grid than for the iron kathode. With the double-sided discharge the current was found to be from two to three times as great as for the one-sided discharge, and considerably greater than for the iron kathode. In the case of the molecular gases the one-sided discharge from the grid always gave currents less than the iron kathode, but the magnification when using the double-sided discharge was as great as for the rare gases. The width of the dark space varied according to the space-charge laws. The results are discussed with reference to the kinetic theory of gases, which apparently does not apply to the kations formed in the dark space. A. W.

V.
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1342. Aston Dark Space in Krypton and Xenon and its Gradual Development in Helium. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 72. 1–2. *pp.* 28–35, *Oct.* 5, 1931.—For Kr and Xe tables are given showing the connection between the Aston dark space, the Hittorf dark space at a magnesium kathode and the gas pressure, for kathode falls ranging from 350 to 600 volts. Using a net grid as kathode for discharges in He it was found that extremely rapid He ions were shot through the kathode up to the kathode of a second glow discharge. The field strength in the dark space of this second discharge could be continuously increased from small values, and thereby the Aston dark space was caused to vary from thicknesses of several cm. down to its normal value. Similar results were not found with other gases. A. W.

1343. Spark-Potential of Argon–Nitric Oxide Mixtures. F. M. Penning. *Zeits. f. Physik*, 72. 5–6. *pp.* 338–343, *Oct.* 21, 1931.—In an earlier paper it was recorded [see Abstract 1171 (1930)] that the spark potential of A was not lowered by small amounts of NO, although the energy of a metastable A atom (11·5 volts) is greater than the ionisation potential of NO molecules (9·5 volts). A further investigation has shown, however, that the absorption of the NO by the iron electrodes which had been previously heated to redness in the vacuum had produced this deceptive result. When the electrodes were previously saturated with NO the lowering of the spark potential of A, through admixture with NO, occurred in the expected manner. H. H. Ho.

1344. Field-Strength in Normal Kathode Fall. M. Steenbeck. *Zeits. f. Physik*, 72. 7–8. *pp.* 505–510, *Oct.* 28, 1931.—It is shown that Rogowski's extension [see Abstract 1637 (1931)] of the theory of Compton and Morse [see Abstract 161 (1928)] leads to quantitatively better results. This does not alter the explanation of the mechanism of the effects occurring near the kathode previously given by the author [see Abstract 1949 (1929)]. A. W.

1345. Atomic-Hydrogen Discharge Tube. E. Lau and O. Reichenheim. *Zeits. f. Physik*, 73. 1–2. *pp.* 31–32, *Nov.* 24, 1931.—In an electric discharge in hydrogen a considerable part of the H_2 is broken down to the H_1 condition. Various means of obtaining a high H_1 concentration are mentioned. An effective and simple means is the admixture of one of the rare gases, of which argon is particularly suitable. The action appears to be not so much a reduction of the recombination of the hydrogen atoms as an effective reduction of the cross-section of the tube, causing an apparent increase of the current density, on which, as Wood has shown, the H_1 concentration depends. The tubes used by the authors contain hydrogen at about 0·2 mm. pressure, that of the rare gas being about 2 mm. One such tube has given a useful life of 500 hours. A. W.

1346. Passage of Hydrogen Canal Rays through Helium. R. Döpel. *Phys. Zeits.* 32. *pp.* 858–860, *Nov.* 1, 1931.—Experiments were carried out to find the difference between the effects of electrons, protons and neutral hydrogen atoms (neutrons) as regards the excitation of helium. Non-homogeneous canal rays of 3 to 70 kV were used, and the helium lines employed were 3889 and 3965 Å. The results obtained show that when a proton of 20 to 30 kV excites helium, such excitation is at least ten times weaker than that due to a neutron. The excitation function is principally a velocity function. For hydrogen canal rays in mercury only the mercury is excited. In helium canal rays below 60 kV only neutral and singly charged atoms of helium are found to exist, no doubly charged atoms occurring. The results are briefly discussed. A. W.

1347. Mercury Arcs at High Vapour Pressures. C. Reczyński. *Comptes Rendus, Polonaise,* 5. *pp.* 287–298, 1931. *German Abstract.*—Measurements were made with mercury arcs relative to the dependence of the electrode p.d. (V) on the current strength (I), the arc length (l) and the vapour pressure (p). Vapour pressures ranging from 0·01 to 525 mm. of mercury were employed. The current strength varied between 0·05 and 5·0 amperes; the arc length between 10 and 300 mm. The results are given in families of curves. With different vapour pressures and a constant arc length of 210 mm. the curves giving V as a function of I for constant pressure show a rapid fall for the smaller current strengths and greater pressures. For small pressures and greater current strengths V is, however, independent of I. The characteristics for the arc discharge and for the glow discharge (p = 100 mm., l = 210 mm.) are similar, but the latter is about 20 volts higher. For constant pressure the relation between V and l is to a first approximation linear, $V = A + Bl$, where A represents the sum of the potentials at the kathode and anode and B the gradient in the positive column. Curves are given relative to the efficiency of the Heræus type of mercury lamp under various operating conditions, and study of these has led to the production of a new lamp with a much greater efficiency. With the ordinary Heræus lamp an emission of about 4 Hefner candles per watt is obtained; with the new lamp this is increased to 9·5 HK/watt. A. W.

1348. Conductivity of the Annular Discharge. M. Pożaryski. and S. Wachowski. *Comptes Rendus, Polonaise,* 5. *pp.* 381–387, 1931. *Polish Abstract.*—Following a discussion of the methods and results obtained by previous workers, an account is given of an experimental investigation of the conductivity of the gas in the annular discharge by a method in which auxiliary electrodes or probes are not used. The authors consider that such electrodes probably introduce errors. In the method described h.f. current is passed through two coils near to one another, of identical windings but arranged so that the currents in them circulate in opposite directions. A third coil, situated between the first two, is joined to a thermal junction and galvanometer and adjusted so that the galvanometer deflection is as small as possible when the gas in the glass sphere surrounded by one of the first two coils is at atmospheric pressure and no luminous effects occur. As the gas pressure is reduced the galvanometer deflection increases owing to the increased intensity of the annular currents and will represent, on some arbitrary scale, the strength of these currents. The results thus obtained show a very pronounced maximum for a particular pressure, which depends on the gas employed. For air the maximum is found at a pressure of about 0·0075 mm., for hydrogen at 0·0034 mm. and for oxygen at 0·0105 mm. The intensity of the h.f. current appears to have no effect whatever on the position of the maximum. The curve obtained for oxygen shows in addition to the pronounced maximum at 0·0105 mm. a slight elevation for a pressure of 0·13 mm. A. W.

1349. Ionising Efficiency of Electronic Impacts in Air. J. Thomson. *Roy. Soc. Edinburgh, Proc.* 51. *pp.* 127–141, 1930–1931.—Experiments are described in which the total ionisation produced in air

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by electrons moving with a given energy is measured. A narrow beam of electrons is produced by sending electrons from a hot filament down an axial hole, 2 mm. in diameter, in a metal anode 14 cm. long. The beam then enters an ionisation chamber containing two parallel electrodes where the pressure is of such a value that the electrons are totally absorbed. A small electrode, facing the entering beam, is used to measure its initial energy. The ions produced are measured by a galvanometer in series with the parallel electrodes. Actually, the minimum potential necessary to saturate the ionisation current is measured. From these measurements the energy required to produce one pair of ions is found. This quantity varies with the initial velocity of the electron, but approaches the value 37 ± 2 electron-volts at high speeds. The author's results are compared with those of other investigators. N. D.

1350. Mass Spectrograph Analyses, and Critical Potentials for the Production of Ions by Electron Impact, in Nitrogen and Carbon Monoxide. A. L. Vaughan. *Phys. Rev.* **38.** *pp.* 1687–1695, *Nov.* 1, 1931.—The dissociation products formed by bombarding nitrogen and carbon monoxide with electrons of a definite velocity have been studied with a mass spectrograph. In the case of nitrogen N_2^+ and N^+ ions appear at 15·8 ± 0·1 and 24·5 ± 0·1 volts respectively. The N^+ ion has kinetic energy and is attributed to $N_2 \rightarrow N^+ + N + e$. Increases in the efficiency of production of the N^+ ion appear at 40·0 ± 1·0 and 47·0 ± 1·0 volts. The largest percentage of the total positive ion current carried by kinetic energy ions is approximately 28 % at 140–160 volts. Efficiency curves of total ionisation and of N_2^+ exhibit maxima at 100·0 ± 5·0 and 60·0 ± 5·0 volts respectively. In carbon monoxide CO^+, C^+ and CO^{++} ions appear at 13·9 ± 0·2, 22·5 ± 0·2 and 43·0 ± 1·0 volts respectively. Maximum numbers of CO^+, C^+ and CO^{++} ions formed per electron per cm. path per mm. pressure at 0° C. are 10·13, 0·50 and 0·14 at 102, 105 and 125 volts respectively. The C^+ ion possesses kinetic energy and is probably due to $CO \rightarrow C^+ + O + e$. Assuming that the CO^{++} ion would dissociate into $C^{++} + O$, the energy of dissociation cannot be less than from 2 to 3 volts. O^- ions are formed between 9·5 ± 1·0 and 16·5 ± 1·0 volts, and again beginning at 22·5 ± 1·0 volts and reach a maximum at 33 volts. The first group is evidently due to the attachment of an electron to the CO molecule followed by a dissociation $CO^- \rightarrow C + O^-$. The second group may be due to $CO \rightarrow C^+ + O^-$. O^- ions are only 2·7 % as numerous as C^+ ions at 30 volts. AUTHOR.

1351. Emission of Negative Ions Under the Bombardment of Positive Ions. K. S. Woodcock. *Phys. Rev.* **38.** *pp.* 1696–1703, *Nov.* 1, 1931.—The results which Sawyer obtained from the reflection of lithium ions from reflectors of platinum foil and nickel crystal deposited on tungsten [see Abstract 3541 (1930)] indicated two distinct angles at which reflection occurs more strongly than at other angles, one coming nearly at the angle of specular reflection as found by Read and Gurney, and the other which appeared only at relatively high voltages, at an angle approximately normal to the reflecting surface. Experiments made by reflecting the lithium ions from a metal surface in a field-free space gave the bundle at the specular angle as before, but no trace of a bundle at the normal to the surface could be found. When a field is applied so as to retard reflected positive ions there was evidence of negative emission coming from the target under the bombardment of lithium ions. A magnetic analysis system was set up to determine the nature of the negative charges. Negative fluorine, chlorine, oxygen and sulphur ions were obtained by bombarding NaF, CaF_2; NaCl, CaO, PbS and oxide-coated vacuum tube filaments. Clean metal targets of platinum, gold, aluminium, tantalum, nickel and tungsten were found to emit electrons and the negative ions H_1^-, H_2^-, OH^- and Cl^- with traces of what is probably N^- and $LiOH^-$. The strongest bundles were the first four which indicate that water-vapour molecules were broken up into their components. AUTHOR.

1352. Action of Positive Ions of Cæsium on a Hot Nickel Surface. P. B. Moon. *Cambridge Phil. Soc., Proc.* 27. *pp.* 570–577, *Oct.* 31, 1931.—Experiments on the emission of secondary electrons from hot nickel surfaces bombarded by positive ions of cæsium at normal incidence show that the emission is a function of both bombarding voltage and target temperature. The emission is negligible below 300 volts and increases steadily with increase of the bombarding voltage above 300 volts, rising to about 14 % at 4000 volts with the target at 950° C. Increase of the target temperature causes the secondary emission to diminish. If positive ions are allowed to evaporate from the hot target the number of positive cæsium ions leaving the surface may, under certain conditions, be equal (to within less than 1 %) to the number arriving in the incident beam, thus confirming a conclusion of Langmuir and Kingdon [see Abstract 1182 (1925)]. A. W.

1353. Measurement of the Mobility of the Ions of Inert Gases. M. J. Druyvesteyn. *Zeits. f. Physik*, 73. 1–2. *pp.* 33–44, *Nov.* 24, 1931.—Certain peculiar striæ formed in Ne, He and A are described. In Ne at 1 cm. pressure, with plane parallel electrodes of Pt 1 cm. apart, they appear as a number of bright yellow sheets parallel to the electrodes, separated by dark spaces. The p.d. between neighbouring striæ is found to be 19 volts. The mobility of the positive ions is calculated from the concentration of the striæ in front of the kathode. Results given are as follows: mobility of + ions in Ne is 9·8 cm./sec., in He 19 cm./sec. and in Ne + 1 % A 5 cm./sec., all given for a field of 1 volt per cm. and one atmosphere pressure. Differences between the author's results and those of other observers are discussed. N. D.

1354. Diffraction of Electrons by Thin Films of Nickel and Copper Oxides. J. A. Darbyshire. *Faraday Soc., Trans.* 27. *pp.* 675–678, *Oct.*, 1931.—The thin films of oxides formed on the surfaces of Ni and Cu strips by heating them in flames are removed by an electrolytic process, washed, and mounted on small brass washers with central holes. They are then attached to the holder of an electron diffraction apparatus. Such films are transparent to light. When an electron beam is transmitted through one of them, and is then allowed to fall on a photographic plate, systems of well-defined diffraction rings are formed. Measurements of the diameters and intensities of the rings show that on Cu the film is the cubic Cu_2O, and that on Ni consists of face-centred NiO. There is good agreement between the spacing and intensity values derived from the films and the standard values for ordinary crystals of these oxides. N. D.

1355. Scattering of High-Velocity Electrons by Thin Foils. H. V. Neher. *Phys. Rev.* 38. *pp.* 1321–1341, *Oct.* 1, 1931.—The " single " scattering of a narrow beam of electrons impinging upon thin foils of Al, Ag and Au with velocities up to 145 kV is investigated, *i.e.*, the dependence of the amount of scattering on the primary energy, atomic number and angle is determined. Wenzel's expression giving a criterion for single scattering is found to increase from 3·3 at 45 kV to 6·1 at 145 kV. Hence a more critical criterion is obtained. Mott's equation and the k/V^2 relation are equally in agreement with the experimental relation connecting primary energy with amount of scattering. In the series Al → Ag → Au the amount of scattering between two given angles increases faster than the square of the atomic number. For angles of scattering from 95° to 173°, Rutherford's equation was found to represent the results with all three metals, and Mott's equation holds for Al but not for the others. Absolute as well as relative values are obtained. N. D.

1356. Diffraction of Electrons in Gases. F. L. Arnot. *Roy. Soc., Proc.* 133. *pp.* 615–636, *Oct.* 1, 1931.—Extends previous work on Hg vapour [see Abstract 2785 (1931)] to various gases, using the same apparatus as before. Measurements of the angular distributions of the elastically scattered electrons arising out of primary beams of several definite velocities between 30 volts and 800 volts have been made in Xe, Kr, A, Ne, H_2, N_2, CH_4 and CO. With slow electrons the inert gases give pronounced diffraction maxima and minima which gradually disappear as the velocity is raised. The molecular gases give a single minimum near 90° at low velocities, the depressions again flattening out with increasing speed. For high-velocity electrons in the rare gases the curves of intensity of the scattered beam plotted against the angle of scattering agree well with those deduced from Born's formula. For the slower 54-volt electrons in Kr the curve agrees well with one deduced from Faxén and Holtsmark's formula. Interesting information has been obtained from curves of effective cross-section for elastic collisions plotted against $\sqrt{\text{volts}}$. N. D.

1357. Elastic Scattering of Slow Electrons in Gases. Part II. E. C. Bullard and H. S. W. Massey. *Roy. Soc., Proc.* 133. *pp.* 637–651, *Oct.* 1, 1931.—Extends measurements of the angular distributions of slow electrons scattered elastically in argon [see Abstract 2784 (1931)] to He, Ne, N_2, H_2 and CH_4, through angles of 20° to 125°. The curves for CH_4 resemble those for A. For He the curves for electrons below 20 volts show definite minima between 60° and 80°. In Ne the 20-volt and 30-volt curves show minima at 120° and 110° respectively. In N_2 the scattered intensity has a minimum which remains at 90° even when the velocity alters. In H_2 and the rest, the position of the minimum depends upon the velocity. It is shown that Born's scattering formula fails to represent the scattering of very slow electrons. Faxén and Holtsmark's formula well represents the behaviour of slow electrons in A and Kr, but is difficult to apply to other cases. The questions of the exchange of electrons between incident beam and atom, the distortion of the electron waves by atoms, and the diffraction of electrons by atoms in diatomic molecules are specially discussed. N. D.

1358. Electron Scattering in Helium. S. Werner. *Roy. Soc., Proc.* 134. *pp.* 202–210, *Nov.* 3, 1931.—The scattering of electrons of volt-velocities between 40 and 300 volts in helium at low pressures is measured for a scattering angle of 90°. The experimental curve is plotted alongside one derived from Mott's theoretical formula. They agree for voltages above 100. Below this value the experimental scattering exceeds the theoretical. N. D.

1359. Mutually Effective Cross-Sections of Argon Atoms and Ions. F. Wolf. *Zeits. f. Physik*, 72. 1–2. *pp.* 42–53, *Oct.* 5, 1931. *Phys. Zeits.* 32. *pp.* 897–899, *Nov.* 15, 1931.—A method of measuring the "mutually" effective cross-sections of gaseous molecules and ions is given. After production in a special chamber, the ions are deflected by a magnetic field into a measuring chamber, their orbits being circles while in the field. The measuring chamber is arranged to give both the effective cross-sections and the velocities of the ions. Details of the apparatus and technique are given. The graph of effective cross-sections of argon atoms against $\sqrt{\text{volts}}$ is approximately horizontal up to 520 volts, and above that rises sharply. The measured effective cross-sections are greater than those expected from kinetic theory. N. D.

1360. Photoelectricity. Q. Majorana. *N. Cimento*, 8. *pp.* 273–280, *Aug.–Sept.–Oct.*, 1931.—Calls attention to what he believes to be a new photoelectric phenomenon. A ring of zinc or aluminium M is surmounted by a light aluminium tube AB suspended by a wire and provided with a mirror S. Ultra-violet light falls on the inclined mirror K and on the ring at T. When the light is turned on, the needle, if positively charged, is attracted to the spot with a force of about 0·01 dyne. The author provisionally attributes this force to the electrons liberated by the light.

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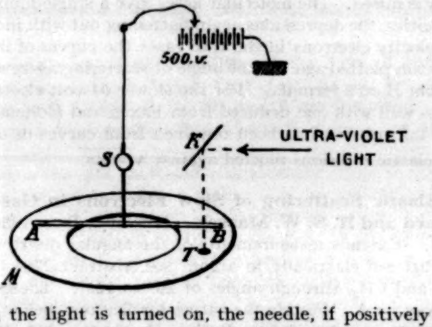

1361. Photoelectric Effect of γ-Rays. H. R. Hulme. *Roy. Soc., Proc.* 133. *pp.* 381–406, *Oct.* 1, 1931.—On the basis of the theory of the Dirac electron, a normalised solution of the equations for the hydrogen-like atom, when the total energy is $> mc^2$, is developed. The perturbation theory is then considered, whence is deduced the total number of electrons emitted and their resultant forward momentum in terms of the matrix elements representing transitions from the ground state to states where the electron is free. The average forward momentum thus deduced is $4h\nu_0/5c$, and not $2h\nu_0/c$ [see Abstract 2650 (1930)]. The matrix elements are evaluated for small values of the atomic number, and a wave-length of the incident light such that the energy of one quantum is comparable to mc^2, *i.e.*, of the order $\lambda = 10^{-10}$ cm. The results agree quantitatively with experiment if variation with atomic number is excluded. C. A. S.

1362. Photoelectric Effect in Thin Metallic Films. W. G. Penney. *Roy. Soc., Proc.* 133. *pp.* 407–417, *Oct.* 1, 1931.—A mathematical treatment is given of the photoelectric current obtainable from a thin metallic film on the assumption that the metal behaves as a potential trough containing a number of infinitely high, infinitely narrow, potential barriers, one for each layer of ions. The model adopted takes into account damping of the incident light wave and the fact that the electrons must be considered as partially bound. There is a considerable gain in agreement with experiment with regard to the variation of the current with the thickness of the film and with the frequency of the light. A. H.

1363. Photoelectric Effect in a High-Resistance Layer and the Hallwachs Effect. E. Perucca and R. Deaglio. *Zeits f. Physik*, 72. 1–2. *pp.* 102–115, *Oct.* 5, 1931.—The authors consider a Lange photocell, composed of a copper plate, one side of which has been oxidised to cuprous oxide, and a metal electrode making contact with the surface of the cuprous oxide. Schottky has found that the photoelectric effect is localised in a thin high resistance layer between the cuprous oxide and the mother copper from which it was formed, the so-called blocking layer, which is responsible for the behaviour of the cell when used as a rectifier, and for almost the whole of its internal resistance. Under suitable conditions the authors have been able to show a saturation in the open-circuit voltage produced by such a cell, when the illumination is increased step by step; and they conclude that the action of the cell is due to a genuine Hallwachs effect, taking place between the surface of the cuprous oxide and the mother copper, through the blocking layer. Metallic rectifier contacts of gold and platinum, as described by Rohmann and Pélabon, do not give a photocurrent. H. N. A.

1364. Atomic Photoelectric Effect in the K-Shell according to the Relativity Wave Mechanics of Dirac. F. Sauter. *Ann. d. Physik*, 11. 4. *pp.* 454–488, *Oct.* 13, 1931.—As an Appendix to a previous investigation [see Abstract 3209 (1931)], the problem of the photoelectric effect in the K-shell has been treated according to Dirac's theory and approximate solutions found for the two limiting cases of $v \sim c$ and $v^2 << c^2$. The direction distribution of the photoelectrons is given essentially by the expression, $J \sim \frac{\text{const.}}{r^2} \cdot \frac{\sin^2\vartheta \sin^2\phi}{(1-\beta\cos\vartheta)^4}$, and the relativity additional term is shown to produce only a small change of distribution. When the absorption coefficients in the K-shell are connected by a λ^n-law, then n must decrease with declining wave-lengths. The influence of the electromagnetic alternating field of the light wave on the magnetic moment of the electron is discussed. H. H. Ho.

1365. Interpretation of the Selective Photoelectric Effect from Two-Component Kathodes. A. R. Olpin. *Phys. Rev.* 38. *pp.* 1745–1757, *Nov.* 1, 1931.—Evidence is produced to support the view that photoelectrically selective, two-component kathodic surfaces are crystalline in nature. Then, assuming that Fowler's equation for the energy of electrons selectively transmitted through a single potential valley [$W = (n^2h^2/8md^2)$] is equally valid for the energy of electrons selectively transmitted through the periodic sequence of valleys characteristic of the potential field within a crystal, and that all of the energy of photoelectrons is acquired from the incident light quanta, the wave-lengths of light to which such a surface should respond selectively can be computed. Such computations have been made with d equal to the internuclear distance between electro-positive ions in the lattice structure of alkali metal hydride, oxide and sulphide crystals. The hydride crystals belong to the sodium chloride type and the oxide and sulphide crystals are supposedly of the calcium fluoride type. The correlation between these computed values and the positions of the observed selective maxima is exceptionally good. Moreover, the fact that the alkali metal hydrides exhibit but one selective maximum and the oxides two or three maxima is in keeping with the geometry of their respective crystalline types. AUTHOR.

1366. Photoelectric Law. N. R. Campbell. *Optical Soc., Trans.* 32. 2. *pp.* 61–64; *Disc.*, 64–65, 1930–1931.—Gives a more rigid proof of the law that the primary electronic emission from the photoelectric kathode is proportional to the amount of radiation incident on it. It is not sufficient to assume the accuracy of the inverse-square law or the law of transmission through crossed nicols. In his crucial experiment the author throws the light from two lamps, first successively and then simultaneously, on the same photoelectric cell and in each case keeps the electrometer at zero by a compensating e.m.f. He shows that only infinitesimal errors can arise. E. E. F. d'A.

1367. Current and Voltage in Photoelectric Crystals. W. Flechsig. *Phys. Zeits.* 32. *pp.* 843–847, *Nov.* 1, 1931.—When an e.m.f. is applied to a crystal, the free electrons are displaced to an extent which, if small, gives a "displacement current" proportional to the e.m.f. As this increases it is replaced by a saturation current. The e.m.f. producing saturation is proportional to the square of the thickness of the crystal. To study the relation between e.m.f. and saturation current in detail, the author develops the method of light probes devised by Gudden and Pohl, reducing them to a thickness of 0·15 mm. The results show deviations from the law of quantum equivalents, which may be due to the difficulty of avoiding grating distortions in thin crystals. E. E. F. d'A.

1368. Physical Model of Blocking-Layer Photoelectric Cells. F. v. Körösy and P. Selényi. *Phys. Zeits.* 32. *pp.* 847–850, *Nov.* 1, 1931. —The authors picture the model of a blocking-layer photoelectric cell as composed of a vacuum photoelectric cell in parallel with a rectifier and a capacity, followed by a non-inductive resistance. They show that such a model shows, qualitatively at least, the same behaviour as a blocking-layer cell. E. E. F. d'A.

1369. Temperature Dependence of the Blocking-Layer Photoelectric Effect. B. Lange. *Phys. Zeits.* 32. *pp.* 850–856, *Nov.* 1, 1931.—Determines the temperature coefficient of cuprous oxide and other cells by means of an apparatus which allows of an exposure to temperatures of −180° to 80° C. In cuprous-oxide cells, the current increases from zero at −180° C. to a maximum at −80° C. thereafter decreasing linearly, with a temperature coefficient of about − 0·0086. In a selenium cell the temperature coefficient was only 0·0003, and the relative influence of the parts of the spectrum remained the same. E. E. F. d'A.

1370. Crystal Photoelectric Cell. H. Dember. *Phys. Zeits.* 32. *pp.* 856–858, *Nov.* 1, 1931.—The absorption of light in the interior of single crystals of cuprous oxide and proustite produces an electronic con-

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densation falling off logarithmically in the direction of the light. This fall of concentration is equivalent to an e.m.f. This photo-e.m.f. causes the electrons to move in the direction of the light. A very strong increase of the light acts like a reduction of the thickness of the layer of crystal, the e.m.f. being reduced in both cases. A similar effect is produced by substituting a layer of small crystals which prevent a deep penetration of the light and so produce the effect of a blocking layer. The pressure of light drives the electrons in the same direction, and adds to the effect.
E. E. F. d'A.

1371. Highly Sensitive Vacuum Photoelectric Cells. M. C. Teves. *Zeits. f. techn. Physik,* 12. 11. *pp.* 556–558, 1931.—Endeavours to increase the sensitiveness of photoelectric cells by maintaining the high vacuum and making the kathode more sensitive by depositing oxides upon it. Thus, by depositing a thick film of mixed oxides upon it, a cæsium kathode can be made to reach a sensitiveness of 65 μA/lumen, although contained in a vacuum. The adsorption can be driven as far as about 1000 molecules. The thicker the layer, the more is the maximum sensitiveness displaced towards the less refrangible rays The number of quanta going to the liberation of one electron is about 25. E. E. F. d'A.

1372. Determination of the Photoelectric Threshold for Tungsten by Fowler's Method. A. H. Warner. *Phys. Rev.* 38. *pp.* 1871–1875, *Nov.* 15, 1931.—The photocurrent per unit intensity curves for two different tungsten surfaces have been replotted by means of the method suggested by R. H. Fowler [see Abstract 3584 (1931)]. The points all fit the theoretical curve very well, although the thresholds for the two surfaces are different. For one surface the data were obtained at temperatures of 1100, 900 and 790° K. The average value of the threshold at 0° K. was 2632 Å., or 4·69 volts, with a greatest difference between individual values of 1·3 %. The thermionic work function of this surface was 4·71 volts. The second surface was investigated at room temperature, and was formed by evaporation after very careful outgassing. The threshold for this surface was 2720 Å. or 4·54 volts at 0° K., which agrees with Dushman's value of 4·54 volts for the thermionic work function at the same temperature. This should be regarded as the most reliable value. [See also Abstract 3147 (1929).] AUTHOR.

1373. Photoelectric Origin of Initial Electron in Electric Breakdown under Surge Potentials. K. Buss and K. Masch. *Arch. f. Elektrot.* 25. *pp.* 744–746, *Nov.* 12, 1931.—Experiments were undertaken to investigate this possibility. A surge potential of duration 7×10^{-8} sec. was applied to a plate spark gap, and to clear the space between the plates of electrons a potential was applied prior to the surge, care being taken that ionisation by collision should not occur. The results obtained are discussed, and it appears improbable that the electron starting the breakdown is of photoelectric origin. A. W.

1374. Variation of Thermionic Emission from a Wehnelt Kathode. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 13. *pp.* 282–286, *Nov.*, 1931.—The emissive power of a Wehnelt kathode, situated in a tube containing a gas, is considerably modified when a heating current is passed through an auxiliary Pt filament, sealed into the same tube. On making the current there is a drop in emission, then a rise to a sharp maximum and finally a decrease until the current is broken. When the tube is heated in other ways, the initial phenomena alter, but there is always a final decrease in emission, as the heating is continued. A theory of these effects, based on the assumption of a surface layer adhering to the kathode, is given. N. D.

1375. Kathodes for Disintegration. W. Hinsch. *Zeits. f. techn. Physik,* 12. 11. *pp.* 528–541, 1931.—Investigations of platinum-barium kathodes showed that by strong heating in the absence of anode e.m.f. a " formation " could be attained, *i.e.*, a decided increase of emission. At the beginning of this process the cell shows no saturation, but a constant increase of current with anode potential. Microscopic study shows an alteration of the platinum surface by the impinging barium. In the course of the formation the surface becomes smooth, an alloy of the two metals being formed. This effect can be reversed by a second imposition of barium. The Richardson constants of a finished fibre were: $A = 32–100$ ampere/deg. cm.^{2}, $\phi = 2{\cdot}3–2{\cdot}5$ volt. E. E. F. d'A.

1376. Diffusion of Electrons Back to an Emitting Electrode in a Gas. I. Langmuir. *Phys. Rev.* 38. *pp.* 1656–1663, *Nov.* 1, 1931.—An expression is derived for the current i between two electrodes, one of which emits (with uniform current density I_0) electrons with an initial volt velocity, V_0, when the electrodes are placed in a gas at such a pressure that the electrons suffer only elastic collisions. If V is the voltage between the electrodes, λ the mean free path of an electron, the current is given by $i = (16\pi/3)I_0\lambda C\phi$ where C is the electrostatic capacitance between the electrodes and $\phi = (V/V_0)ln(1 + V/V_0)$. If the emitted electrons have a Maxwellian velocity distribution, this equation is applicable with slightly modified values of ϕ, V_0 now being replaced by T/11,600 volts. AUTHOR.

1377. Development of an Electron-Emitting Alloy. O. S. Duffendack, R. A. Wolfe and D. W. Randolph. *Am. Electrochem. Soc., Trans.* 59. *pp.* 181–197; *Disc.,* 197–198, 1931.—It was discovered that irregularities in the sparking voltage of spark gaps were due to non-uniformities in the composition of the electrode materials. Small inclusions of Mg in the nickel alloy ordinarily employed for spark plug electrodes were found to be distributed at random through the wire and to affect the sparking voltages. A thorough investigation established a complete coordination between the sparking voltage of a gap and the work function of electron extraction from the kathode surface. The sparking voltage of a standardised gap increases when the thermionic electron emission of the electrode wire, measured under standardised conditions, decreases. After many experiments, a nickel alloy containing barium has been developed which is homogeneous in composition and readily reproducible. Spark gaps having electrodes made of this alloy have very constant sparking voltages. The alloy has marked electron-emitting properties that make it valuable for use in various electrical devices. Its uses in several ways are being developed. [See also following Abstract.] AUTHORS.

1378. Sparking Potential and Electrode Material. L. B. Loeb. *Phys. Rev.* 38. *pp.* 1891–1897, *Nov.* 15, 1931.—A consideration of the character of the normal spark breakdown in air with external ionisation and involving time lags of greater than 10^{-4} sec. indicates that with the assumption of space charges the original Townsend theory of sparking can be maintained and that the spark mechanism as is experimentally found will be independent of electrode material. It is shown that the results of Duffendack, Wolfe and Randolph [see preceding Abstract] in which they find a dependence of sparking potential on the work function of the electrodes is due to their special experimental arrangement and in no sense contradicts the Townsend theory as asserted by them. It is shown that short time (less than 10^{-4} sec.) surge impulse breakdown in gaps of small area with insufficient ionisation necessitates a new breakdown mechanism involving probable impact ionisation at the kathode by positive ions to replace the deficient ionisation. On the basis of this point of view further much-needed investigations are indicated. AUTHOR.

1379. Measurement of H.F. Alternating Magnetic Fields. F. Esclangon. *Comptes Rendus*, 193. *pp.* 577–579, *Oct.* 12, 1931.—The method depends on the measurement of the heating effect of the Foucault currents produced in a conductor of simple shape, *e.g.*, the cylindrical reservoir of a mercury thermometer. The power absorbed, which, provided that d, the diameter of the cylinder is small, $= dH^2\sqrt{N\rho}/(8 \times 10^7)$ watt, where N is the frequency, ρ the resistivity of mercury, and H the effective field intensity, is deduced from the velocity of heating. Necessary precautions are discussed. The method is suitable for fields of a few score gauss, of frequency of the order of 10^7 per sec. C. A. S.

1380. Ionised Gases and the Action of Positive Grid Valves. T. V. Ionescu. *Comptes Rendus*, 193. *pp.* 575–577, *Oct.* 12, 1931.—Barkhausen's formula is deduced from the natural period ν of the ionised gas [see Abstract 3198 (1931)]. As a positive grid valve functions when the grid potential is sufficient to give the saturation current, and the oscillations of the ionised gas, of frequency ν, are maintained by bundles of electrons (of frequency ν', dependent probably on the internal dimensions of the valve), there must be resonance before the vibrations start, *i.e.*, either $\nu = \nu'$, in which case Barkhausen's formula applies; or ν is a multiple of ν', when vibrations are obtained not in accord with Barkhausen's formula. The diminution in wave-length with increased pressure as well as on heating the filament, grid potential remaining constant, is explained by increased density of ionisation near the grid. [See also Abstracts 833, 834 (1926) and following Abstract.] C. A. S.

1381. Oscillations in Positive Grid Valves. A. Rostagni. *Comptes Rendus*, 193. *pp.* 1073–1075, *Nov.* 30, 1931.—The expression for the constant in Barkhausen's formula, $\lambda^2 V =$ constant, where V is the grid potential, as deduced by Ionescu [see preceding Abstract], depends on the ratio (number of positive ions)/(number of electrons). The number of ions thence deduced is inconsistent with observation in the case of high vacuum valves. Ionescu's results cannot therefore be valid for such, though possibly so for valves with appreciable gas pressure. For electronic oscillations a wave-length $3 \cdot 35 \times 10^6\sqrt{v/N}$, where N is the number of electrons and v the volume enclosed by the armatures, is deduced, giving results in accord with observation. As N depends on both v and the emission current, the relation $\lambda^2 v =$ constant is only a special case. C. A. S.

1382. Diamagnetism of Free Electrons in Metals. P. Y. Chou. *Tsing Hua Univ., Sci. Reports, Ser. A.* 1. *pp.* 1–8, *April* 15, 1931.—Bohr has stated that free electrons in a metal contribute nothing to diamagnetism, but according to Landau the susceptibility has a definite value [see Abstract 989 (1931)]. By taking into account the collisions of orbits, the author shows that free electrons within a metal have zero diamagnetic susceptibility. G. E. A.

1383. Determination of the Paramagnetic Susceptibility of Chromic Chloride and its Hexahydrates. J. W. Shih. *Tsing Hua Univ., Sci. Reports, Ser.A.* 1. 2. *pp.* 83–91, 1931.—The paramagnetic susceptibilities of anhydrous chromium chloride, the green hexahydrate and the greyish-blue hexahydrate were determined by a method analogous to that of Foëx. The molecular susceptibilities were very different in the three cases. The divergence cannot be explained by assuming Pascal's additive law and taking the diamagnetic susceptibility of six molecules of water of crystallisation as 78×10^{-6}, which is a small percentage of the total molecular susceptibility. The six molecules of water of crystallisation when appearing as water of constitution decrease the molecular susceptibility from 705×10^{-5} for the anhydrous salt to 336×10^{-5} for the grey hydrate. In the change of two molecules of water from crystallisation to constitution, *i.e.*, to the green hydrate, the molecular susceptibility rises to 640×10^{-5}. This suggests that the water of crystallisation increases the distance between the atomic or molecular magnets, and has the effect of separating a group of such molecular magnets which previously formed a complex structure when anhydrous. Under these conditions it is postulated that, on account of mutual cancellation by coupling among the magnetic constituents much of the atomic or molecular magnetism is unrevealed when the water is absent. S. G. B.

1384. Variations of Susceptibility of Paramagnetic Ions under the Action of Light. O. Specchia. *N. Cimento*, 8. *pp*. 291–297, *Aug.–Sept.–Oct.*, 1931.—Preliminary results of an investigation into the variation of the magnetic moment of the chromium ion under the action of light, and description of apparatus for showing small variations of magnetic susceptibility. A. D.

1385. Magnetic Susceptibilities of Liquid Mixtures. S. P. Ranganadham. *Indian Journ. Phys.* 6. *pp*. 421–431, *Nov.* 30, 1931.—An improved Quincke method has been developed for the determination of the diamagnetic susceptibilities of liquids. A photographic method of measurement, rendered possible by an optical device, was made use of to record the rises of the liquids in two tubes placed side by side between the parallel pole-pieces of an electromagnet. It is found that this method of measurement gives greater accuracy than the other existing methods. Using the above method, the susceptibilities for four liquid mixtures in varying concentrations were determined. In general the susceptibilities of the liquid mixtures followed an approximately linear law. The results do not support those recorded by Trew and Spencer, who report large deviations from the linear law [see Abstract 2803 (1931)]. With mixtures of acetone-chloroform, and water-alcohol, compound formation is indicated. AUTHOR.

1386. Temperature Variation of Intrinsic Magnetisation and Associated Properties of Ferromagnetics. E. C. Stoner. *Phil. Mag.* 12. *pp*. 737–763, *Oct.*, 1931.—Ferromagnetic phenomena are divided into two groups, the general characteristics of both of which may be qualitatively explained by assuming the existence of an intrinsic or spontaneous magnetisation which varies with the temperature and is approximately equal to the saturation magnetisation. Evidence is summarised for regarding ferromagnetism at ordinary temperatures as due to the interchange interaction of electron spins, and an idealised ferromagnetic is visualised in which the magnetic properties are due entirely to electron spin interaction. Values are calculated for the variation with temperature of certain magnetic properties of this ideal body, and there is fair agreement between these and the corresponding observed characteristics of nickel. At higher temperatures the magnetic properties may be interpreted in terms of a resultant spin moment for the atom as a whole and a partially effective orbital moment. [See also Abstract 4108 (1930).] G. E. A.

1387. Ferromagnetism and Electrical Characteristics. Part III. K. Schneiderhan. *Ann. d. Physik.* 11. 4. *pp.* 385–405, *Oct.* 13, 1931.—The work was performed upon Ni wire containing 0·6 % of Mn and upon pure Ni, also in the form of wire. Full experimental details are recorded. It is shown that the increase in resistance due to magnetisation below the Curie point is saturated at the same time as the magnetisation. The increase of resistance is dependent on the magnetisation J according to an expression $\Delta R = c(J^2 - J_0^2)$. It is independent therefore of any variations in magnetisation due to field or temperature, or in relationship to the remanence value. The value of J_0 is only definite for a monocrystalline body. For polycrystalline materials it is strongly dependent on the structure, and is smaller in value the harder the material. [See also Abstracts 985 and 2800 (1931).] S. G. B.

1388. Ferromagnetism and Phase Formation in the Two Component System Nickel-Manganese. S. Kaya and A. Kussmann. *Zeits. f. Physik,* 72. 5–6. *pp.* 293–309, *Oct.* 21, 1931. *From the Reichsanstalt.*—Nickel-manganese alloys containing between 12 and 40 % manganese, which under ordinary conditions are only feebly ferromagnetic (paramagnetic), may be transformed into a strongly ferromagnetic state by prolonged thermal treatment at temperatures below 450°. Alloys with about 23 % of manganese increase their magnetisation from $4\pi J_\infty \sim 300$ to $4\pi J_\infty = 7400$, and attain a magnetisability about 20 % higher than that of pure nickel. Simultaneously the electrical conductivity is increased. By heating to high temperatures followed by rapid quenching, these anomalous magnetic and electrical properties can be made to disappear. It is shown that the transformation from the feeble to the ferromagnetic state takes place in the homogeneous phase without recrystallisation, and can be regarded as the formation of an ordered distribution of the two atomic species in the space lattice corresponding to the atomic composition Ni_3Mn(= 23·7 % Mn). The course of the transformation and temperature-content diagram for the nickel-manganese alloys containing up to 40 % of manganese has been established by magnetic, electrical, metallographic and X-ray measurements. H. H. Ho.

1389. Beryllium Ferrite and the Ferric Oxide Resulting from its Decomposition. H. Forestier and M. Galand. *Comptes Rendus,* 193. *pp.* 733–736, *Oct.* 26, 1931.—Recent work on the structure of the ferrites Fe_2O_3, MO has shown that these oxides may have one of two structures according to the ratio of the size of the diameter of the ion O to the ion M, *i.e.*, whether this ratio is greater than 0·96 (hexagonal) or less than 0·62 (cubic). Their magnetic properties depend on the type of structure. The small diameter of the beryllium ion led to the thought that possibly a third type of structure could be found. This is the object of the present work, together with the study of the formation of the oxide and its magnetic properties. By X-ray and other analysis it is shown that a third type of structure exists in this case and, furthermore, the mechanism of formation of the sesquioxide of iron which is susceptible to magnetisation is the same as that of the Malaguti oxide formed by dehydration of certain ferric hydrates, both artificial and natural. The atom of beryllium in the present case plays apparently the same rôle as that of the molecule of hydrogen in the compound Fe_2O_3,H_2O. Experimental details are summarised. S. G. B.

1390. Permanent Electric and Magnetic Moments of Crystals. F. Zwicky. *Phys. Rev.* 38. *pp.* 1772–1781, *Nov.* 1, 1931.—In the first part of this paper the conditions for the existence of self-perpetuating electric moments in crystals are discussed. If these conditions are satisfied, the crystals must either show macroscopic electric moments or they will necessarily possess a definite type of a secondary structure. Certain complications may come in, however, if one is dealing with metals. Finally, the analogous magnetic case is qualitatively discussed. AUTHOR.

1391. Ferromagnetic Moments and the Periodic System. C. Sadron. *Comptes Rendus,* 193. *pp.* 1070–1073, *Nov.* 30, 1931.—The magnetic moments of the following in solid solution in nickel or copper are: Cu, 2·09; Au, 2·3; Si, 17·8; Sn, 18·0; V, 23·0; Sb, 24·4 Weiss magnetons. They support the previous conclusion [see Abstract 3233 (1931)] that elements in the same column of the periodic table have the same moment. To this rule ruthenium is an exception, its moment being 11, that of pure iron, and not that of iron in nickel, 14. Assuming the rule to hold the moments of elements in the line of iron, plotted against atomic weight, show an ascending (Cu-V) and a descending (V-Ni) branch with intervals of approximately 5 and 4 magnetons respectively. The difference between scandium and titanium is an exception, being 6. C. A. S.

1392. Variations of Atomic Moment of Paramagnetic Materials. G. Foëx. *J. de Physique et le Radium,* 2. *pp.* 353–375, *Nov.*, 1931.—A substance is able to assume, in general, several different magnetic conditions or states quite distinct from each other, and characterised individually by a separate value of the magnetic moment of the ion, and a corresponding value of the constant θ from the law of Weiss (Curie point). The change of state is due to the action of the temperature, and the experimental curve, representing the inverse of the magnetisation coefficient as a function of the temperature, is composed of linear segments at sharp angles to each other. The coefficient of magnetisation variations shows continuity from one state to another, but the variation of the magnetic moment exhibits discontinuity in the transition. These effects are produced simultaneously in all atoms of the material. In general they contain a small number of Weiss magnetons rarely five in number. The variations are reversible and the direction of variation follows according to the substance. All variations of the moment entail a variation of the value of θ, but the latter can, on the contrary, vary largely without the former being influenced. Observations, due to a number of authors, are quoted for a diversity of substances. The second portion of the paper is devoted to a study of substances, different samples of which are able to assume different moments within the same temperature interval. They constitute varieties of the same material which are magnetically different. Two cases are recorded: (1) Those due to known circumstances, *e.g.*, crystalline structure, nature of solvent, etc., thus yielding samples quite distinct. (2) Where the cause is unknown, even when the interior structure appears identical. A sample may be taken through several magnetic states without the cause being known. These magnetic varieties appear to be similar to those of different spectral conditions. In the majority of cases Weiss' law holds rigidly for these materials. Uniformity of magnetisation throughout the sample again appears to be the rule. S. G. B.

1393. Magnetostriction of Ferromagnetic Substances. M. Kersten. *Zeits. f. Physik*, 72. 7–8. *pp*. 500–504, *Oct*. 28, 1931.—For Ni hitherto only negative magnetostriction values were found, but recently Dietsch [see Abstract **4313** (1931)] by measurement of the magnetostriction of Ni along the hysteresis loop has proved the occurrence of positive values also. Dietsch imputes this hitherto unknown phenomenon to the small sensitiveness of the earlier measurements. In the present theoretical paper it is shown that the observed effect is one that should be expected. J. J. S.

1394. After-Effect Phenomena of Hysteresis at High Temperatures. H. Kühlewein. *Phys. Zeits*. 32. *pp*. 860–864, *Nov*. 1, 1931.—A theoretical and experimental discussion of the Forrer hypothesis that by extrapolation of the Curie–Weiss law $\chi(T - \theta) = C$ for $1/\chi = 0$ the paramagnetic Curie point (θ_p) is derived. According to Forrer, this is identical with the extrapolated point of the zero value of the critical field strength or the coercive force respectively. The experimental work was done on alloys and materials of which the magnetisation factor was not negligible and in consequence was accomplished by the usual ballistic ring method. Nickel and nickel-iron-cobalt alloys are discussed. The hysteresis loop for nickel becomes smaller for increasing temperature. In the neighbourhood of the Curie point the loop becomes coincident with the origin of the axes of coordinates for both rise or fall of temperature, *i.e.*, the saturation range is reversible. The paper follows a discussion on the relative values of θ_p and θ_f either above or below each other. The relative action of intercrystalline strains and elastic deformation of the crystalline structure upon the coercive force and the magnetostriction is suggested. S. G. B.

1395. Magnetic Spectra Produced by Magnetic After-Effect. W. Arkadiew. *Zeits. f. Physik*, 72. 1–2. *pp*. 116–124, *Oct*. 5, 1931.—The most rapid parts of the magnetic after-effect, also known as magnetic viscosity, last for some millionths of a second. They were observed by Wwedensky in iron wires from 0·08 to 0·04 mm. in diameter, and show a retardation of the demagnetisation which appears to be due to the molecular properties of the iron, and not to eddy currents. The time in which the magnetisation falls to half its original value is of the order of 10^{-7} to 10^{-6} sec., depending on the magnetic field intensity. It seems probable that in alternating fields of the order of magnitude of about 10^6 this will cause a diminution in the permeability. The author proposes a theory of the subject, which attempts to explain the fall in apparent permeability μ_k, which has been arrived at experimentally by different observers. H. N. A.

1396. Magnetic and Electrical Spectroscopy. W. Arkadiew. *Zeits. f. Physik,* 72. 1–2. *pp.* 125–129, *Oct.* 5, 1931.—The magnetic spectra observed by Malov and Strutt appear to be connected with the decay of magnetisation observed by Gildemeister and Wwedensky. On the basis of the latter phenomenon the author has obtained the formulæ for magnetic dispersion and absorptions in ferromagnetic materials. He starts from the exponential law of the decay of magnetisation which has been assumed by him. This is also known as magnetic after-effect. Previous work by the author gave tables and formulæ which supplied a general exposition of the laws of wave propagation in dielectrics and ferromagnetic materials with resonating centres. The present paper gives a similar treatment for media in which the centres are strongly retarded. This corresponds to the case of dispersion in a dielectric with polar molecules (electrical dipoles). H. N. A.

1397. Permeability at High Frequencies. W. Arkadiew. *Ann. d. Physik,* 11. 4. *pp.* 406–422, *Oct.* 13, 1931.—A note on the work of R. Michels and M. Wien [see Abstracts 3221 and 3222 (1931)]. A long and detailed argument taking each point of these papers *seriatim* and discussing them fully. The present author takes exception to the statement of Michels regarding his definition of "magnetic conductivity," and states that the deductions do not correspond to the facts. The paper is argumentative throughout. **M. Wien** replies [*ibid.*, 11. 4. pp. 423–428, Oct. 13, and 11. 6. p. 736, Nov. 10, 1931]. S. G. B.

1398. H.F. Permeability of Iron and Nickel. M. J. O. Strutt. *Zeits. f. Physik,* 72. 7–8. *pp.* 557–558, *Oct.* 28, 1931.—A reply to the criticism of Malov [see Abstract 594 (1932)] in regard to an apparent discrepancy in the values for μ given in the author's previous work [see Abstract 3223 (1931)]. The author states that he took the apparent discrepancy into consideration in his discussion, assigning its cause to other factors, which enter into the phenomenon. The experimental errors of such measurements are wide, and he attributes thereto most anomalous results obtained within the frequency range of 10^6 to 10^8 hertz. S. G. B.

1399. Experimental Investigation of the Problem of the Two Curie Points. R. Forrer. *J. de Physique et le Radium,* 2. *pp.* 312–320, *Oct.,* 1931.—The ferromagnetic state is distinguished by the existence of two Curie points [see Abstract 2659 (1930)]. The paramagnetic Curie point θ_p is identical with that of coercive force θ_h, and θ_h is in general higher than the ferromagnetic Curie point. θ_f. The alloy nickel-copper is employed to verify the relation $\theta_h = \theta_p$. In magnetite the ferromagnetic and paramagnetic Curie points coincide. In ferro-cobalts the spontaneous magnetisation disappears rapidly at the paramagnetic Curie point. At this temperature the coercive force has a definite value and not the expected zero value. It is therefore concluded that the rapid loss of spontaneous magnetisation is due to a change of magnetic state which is accompanied by a change in the Curie point. G. E. A.

APPARATUS AND INSTRUMENTS.

1400. Electromagnet for Investigating Magnetic Properties of Atoms and Molecules. E. J. Shaw. *Rev. Sci. Instruments,* 2. *pp.* 611–617, *Oct.,* 1931.—The design resembles that of Boas and Pederzani [see Abstract 988 (1924)]. It is specially designed to avoid heating of the coils, allow a larger region of field, reduce the stray field, and be easily assembled. The pole pieces are 4″ or 5·5″ cylinders. A current of 12·5–13 amperes caused heating to 40–50°, and one of 25 amperes would probably cause no damage. With pole faces 10 and 75 mm. apart 1·2 and 12·0 amperes produced fields ($\times 10^{-3}$) of strengths 23 and 3·3, and 148 and 37·2 c.g.s. respectively, the residual magnetism with a 10 mm. gap being 1200 gauss. The reluctance of the core is approximately equal to that of 1 mm. air. C. A. S.

1401. Practical Magnetometer for Iron Investigation. K. Kuhlmann. *Arch. f. Elektrot.* 25. *pp.* 776–780, *Nov.* 12, 1931.—The author stresses the importance of accurate and simple methods of measurement of magnetic factors concerning iron for the engineer. He suggests a ready method using a magnetometer, depending on the earth's magnetism as the balancing force. The usual magnetometer arrangement is supplemented by five solenoids: (1) That in which the test piece is placed, shaped as an ellipsoid. (2) A compensation coil for the field from (1) without the ellipsoid inside. (3) One concentric with (2) and to compensate for iron ellipsoid test piece alone. (4) and (5) For compensation or strengthening of the earth's field. The needle lies in the direction of the axes of (4) and (5) and at right angles to the axes of (1), (2) and (3). The whole magnetometer is rotated to bring the needle into the zero position as above and then the test ellipsoid introduced. The paper gives the theory of the instrument in full and shows how it may be utilised to measure the various magnetic constants and characteristics of the sample. S. G. B.

1402. Application of Deviation and Zero Methods to the Electromagnetic Measure of Small Deformations. A. Guillet. *Comptes Rendus*, 193. *pp.* 1068–1070, *Nov.* 30, 1931.—To obtain quick and precise measurement of small linear or angular deformations of an elastic nature, the displacement is transmitted with or without amplification to one circuit of a transformer having no iron and constructed to undergo changes of mutual inductance proportional to the displacement of the moving circuit. The use of a galena detector for this purpose is explained and the method of amplification. For the zero method the galena is unsuitable, because of loss of sensitivity near zero and with constant e.m.f. a triode interruptor is used, two transformers being placed in series. This gives a comparator of magnified power while experimental factors such as intensity of current and frequency need not be constant. The sensitivity of the receiver allows opposed variations of mutual inductance to compensate. [See Abstract 1408B (1930).] R. S. R.

1403. Potentiometer Recorder. T. R. Harrison. *Rev. Sci. Instruments*, 2. *pp.* 618–625, *Oct.*, 1931. *Journ. Sci. Instruments*, 9. *pp.* 19–21, *Jan.*, 1932.—Diagrammatic illustrations of the potentiometer are given with an account of its special features: the galvanometer contacting and pen-driving mechanisms, the slide wire assembly, and the devices for equalising the cold-junction temperature and for compensating humidity. C. A. S.

1404. Voltage Regulator for Furnace Control. V. H. Stott. *Journ. Sci. Instruments*, 8. *pp.* 313–316, *Oct.*, 1931.—A regulator of simple construction is described, which is capable of maintaining, for long periods of time, an accurately constant " root mean square " voltage in the circuit of an electric resistance furnace. It is shown that, in ordinary circumstances, a laboratory furnace of medium size, controlled by the regulator, exhibits very small temperature changes, the ordinary day and night variation being inappreciable. The regulator may be used for the largest furnaces by the addition of a relay, or relays, of suitable current-carrying capacity. It cannot be damaged by failure of the power supply, and returns to normal operation when the supply is restored. AUTHOR.

1405. Electrostatic H.T. Voltmeter for High Frequency. E. Wilkinson. *Journ. Sci. Instruments*, 8. *pp.* 350–355, *Nov.*, 1931.—The paper describes an electrostatic voltmeter of small capacity with a straight-line calibration. The normal range of indication is 6 to 30 kV; the deflection being measured by means of a ray of light reflected on to a calibrated scale from a mirror mounted on the moving element of the instrument. By altering the connection of the three electrodes it is possible to halve the range of pressure indication. Since the capacity is very small, the instrument can be used to measure h.f. voltages without passing a large current. The different forms of electrode suggested, operating on the same principle to give a straight-line calibration, are discussed and calibrations are given. The method of design is mentioned and typical curves explain this method. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

1406. H.T. Kathode-Ray and X-Ray Tubes and Their Operation. W. D. Coolidge, L. E. Dempster and H. E. Tanis, Jr. *Physics*, 1. *pp.* 230–244, *Oct.*, 1931.—A discussion in detail of important points in the design and manufacture of discharge tubes intended for high voltages: examples of points discussed are thickness of glass, size of bulb, design of arms of tube, freedom from metal deposits, relative position of electrodes, suitable electrode material and preliminary degassing, cold kathode effects, cascading, magnetic focussing. Reference is made to several forms of h.t. generator outfits, including a transformer without rectifier, a full-wave transformer kenotron outfit, a constant potential d.c. outfit, and an induction coil. An embodiment of the latter for 900 kV and 5 mA which has been installed for experimental therapy is described. In the industrial field it seems that such h.t. X-ray equipment will be used for the radiography of thick sections of metal. A tube can be much smaller for given voltages when operating in oil, and it is thought that in future discharge tubes for very high voltages will be operated immersed in the same oil as the h.t. source, and with no portion of the high potential circuit exposed to air. This will greatly reduce the space required and the electrical risks. W. V. M.

1407. Medical Use of Ultra-Short Electromagnetic Waves. P. Rondoni and G. Mezzadroli. *Accad. Lincei, Atti*, 14. *pp.* 169–173, *Sept.*, 1931.—Transplantable adenocarcinoma of the rat when subjected for several hours to ultra-short electromagnetic waves 3 m. in length has its rate of growth increased. E. E. F. d'A.

1408. Sensitivity of the Human Body towards Weak Alternating Current. E. Albers-Schönberg. *E.T.Z.* 52. *pp.* 1249–1250, *Oct.* 1, 1931.—Tests of sensitivity to 50 ∼ 220 volt a.c. were carried out upon men and women of varying occupations, as regards their capability of withstanding painful sensation and detection of small currents. The human resistance was measured by means of a substitution method and was found to vary between 8000 and 15,000 ohms and much dependent upon the humidity of the subject's hands. It was found that at this voltage a current of 0·4 to 0·5 mA was the maximal current permissible, particularly with women, in relation to the painful effects experienced.

B. J. L.

1409. Comparative Biological Action of High-Frequency and Very High-Frequency Currents. J. Saidman. *Comptes Rendus*, **193.** *pp.* **783–785,** *Nov.* **3, 1931.**—The effect of very high frequency ($> 15 \times 10^6$ hertz) is very similar to that of h.f. currents as described by d'Arsonval. They differ in exerting a stronger analgesic effect, frequently with entire absence of other sensation, but sometimes with one of warmth, and in not affecting the respiratory exchange. [See also Abstract 2466 (1931).]

C. A. S.

1410. Selective Heating by Short Radio Waves and its Application to Electrotherapy. J. C. McLennan and A. C. Burton. *Canad. J. of Research*, **5.** *pp.* **550–566,** *Nov.*, **1931.**—In the first part of the paper the theoretical basis of the formulæ, given in a previous communication, for the generation of heat in a poorly conducting dielectric which is placed in the field of a h.f. oscillator, is examined in some detail. Its application to the complicated case met with in medical "radiothermy" is made, and it is shown that the analysis applies with satisfactory accuracy to this case, though not to that of electrode diathermy. Prediction of the "selective" effect is possible from a knowledge of the characteristic electrical constants of the body-substances at high frequencies, and by proper choice of wave-length the heat of a particular part might be favoured over that of neighbouring parts. In the second part of the paper, experimental work is described which carries verification of the formulæ to shorter wave-lengths. Experiments on the heating of meat demonstrate the selective effect and its dependence upon wave-length. The heating of such substances as liver, heart and the different parts of an egg is examined experimentally as examples of the various determining factors that are involved. The theoretical explanation of the effects is considered satisfactory, and further developments depend upon the results of *in viva* experiments with shorter wave-lengths than those at present in general use.

AUTHORS.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

1411. Adsorption of Hydrogen by a Zinc Oxide—Chromium Oxide Catalyst. F. E. T. Kingman. *Faraday Soc., Trans.* 27. *pp.* 654–661, *Oct.,* 1931.—Continuing the work described earlier [see Abstract 3987 (1931)], the present paper refers to the adsorption of hydrogen on the zinc oxide-chromium oxide catalyst at − 80°, 0°. and 100° C. The variation in the rates of adsorption with reduction of the catalyst is also investigated. It is shown that three types of adsorption occur, namely, (i) van der Waals' adsorption, (ii) adsorption with a high heat of activation without leading to the reduction of the catalyst and (iii) adsorption on the oxygen atoms of the surface leading to reduction of the catalyst. J. K.

1412. Adsorption of Water and Ethyl Acetate Vapours by Silica Gels. A. L. Elder and O. L. Brandes. *J. Phys. Chem.* 35. *pp.* 3022–3024, *Oct.,* 1931.—The present paper refers to a comparative study of the adsorbing powers of Holmes' chalky silica gel and of Patrick's commercial gel under similar conditions. It is shown that at relatively low partial pressures Patrick's gel is more efficient than Holmes' chalky gel for adsorbing either water or ethyl acetate from an air stream. At higher partial pressures Holmes' chalky gel has the larger adsorption capacity for either water or ethyl acetate. J. K.

1413. Coherer Method of Determining Heats of Adsorption. S. Lenher and G. H. Cameron. *J. Phys. Chem.* 35. *pp.* 3082–3085, *Oct.,* 1931.—Repetition of Palmer's experiments on the coherer method of determining heats of adsorption gave very erratic values for the cohering voltages of tungsten filaments in hydrogen, oxygen and nitrogen, and in vacuum, even under the most carefully controlled conditions. The mechanism assumed by Palmer for the coherer process is regarded as improbable, and this view is supported by the extreme differences between Palmer's heats of adsorption and the values obtained by other workers. H. F. G.

1414. Heat of Absorption of Hydrogen by Palladium Black. L. J. Gillespie and H. A. Ambrose. *J. Phys. Chem.* 35. *pp.* 3105–3110, *Nov.,* 1931.—The hydrogen was absorbed at pressure of between one and two atmospheres and a temperature of 0° C. The heat of absorption is 9280 cal. F. J. W.

1415. Exceptional Isotherm at 0° C. of the System Palladium-Hydrogen. L. J. Gillespie and J. H. Perry. *J. Phys. Chem.* 35. *pp.* 3367–3370, *Nov.,* 1931.—An exceptional pressure-composition isotherm has been observed at 0° C. for the Pd-H_2 system which appears over a part of its range to represent a metastable region. F. J. W.

1416. Adsorption and Activation of Carbon Monoxide at Palladium Surfaces. H. S. Taylor and P. V. McKinney. *Am. Chem. Soc., J.* 53. *pp.* 3604–3624, *Oct.,* 1931.—The activity of Pd in the complete reduction of nitrobenzene to aniline has been studied, as well as the effect of solvents in relation to their desorption of the reaction product, water, from the surface of the catalyst; the reduction is more rapid at higher temperatures but coagulation of the catalyst then occurs. Styrene is obtained in 20 % yield by dehydrogenation of ethylbenzene over Pd-black at 400° or by passing air with the vapour over a supported catalyst at lower temperatures. CO does not reduce palladium oxide and is itself a powerful inhibitor to the reduction of the oxide by H_2; no carbon is formed and no CO decomposed by Pd below 350°. Active Pd reduced from the oxide is effective in the reduction of CO to CH_4 between 250° and 350°, but soon becomes sintered. The isotherms of the adsorption of CO by Pd at temperatures ranging from 86° to 553° K. and the corresponding isobars indicate two forms of adsorption, that at the higher temperatures requiring an activation energy. The heat of activated adsorption is calculated as 15,000 cal. per mol. on the less active portions of the surface. Determination of the effect of the change of temperature on the amount of adsorption furnishes a practical method for investigating the various forms of adsorption. T. H. P.

1417. Solutions for Colorimetric Standards. Part V. J. P. Mehlig and M. G. Mellon. *J. Phys. Chem.* 35. *pp.* 3397–3414, *Nov.*, 1931.—The use of certain systems for use in the determination of pH values proposed in a series of published papers is continued [see Abstract 2830 (1931)]. The colours were examined by a spectrophotometric method, and a number of solutions having the same colour for a definite concentration were evolved. It was found that a solution of cupric chloride and of cupric sulphate had the same colour at a concentration of 0·25 *M* with 1 % HCl as the solvent. The use is recommended of permanent standards consisting of a series of solutions of salts of cobalt, iron and copper for comparison with the colour tints produced by two colour indicators in the determination of hydrogen-ion concentrations. F. J. B.

1418. Structure of Very Thin Surface Films on Liquids: Two-Dimensional Systems. E. Heymann. *Kolloid Zeits.* 57. *pp.* 81–101, *Oct.*, 1931.—Recent work in this field is summarised. The theoretical treatment of films on liquids, which in many but not all cases are of monomolecular thickness, is comparatively simple and reveals numerous analogies to the laws of three-dimensional systems. The conditions favouring the formation of mono- or poly-molecular films are discussed. T. H. P.

1419. Diffusion of Colloidal Particles. Part III. H. R. Bruins. *Kolloid Zeits.* 57. *pp.* 152–166, *Nov.*, 1931.—Experimental data show that the retardation of the diffusion of hydrophilic colloids by very slight additions of electrolytes (the ion-effect) is quantitatively reversible; it appears immediately after the addition and undergoes no subsequent change. The diffusion of electrolyte-free gum arabic in pure water is greatly hindered if a very small quantity of one of the opposite ions of the colloid is added to the water. Also casein, sufficiently far removed from its isoelectric point, shows abnormally high diffusion velocity and marked retardation of diffusion. The ion-effect and the lowering of the viscosity by addition of electrolyte follow parallel courses. These two phenomena are considered in relation to the influence of the ionic atmosphere. Nernst's theory of the diffusion of electrolytes, with simple assumptions, is applied to the case of colloidal diffusion and a quantitative expression for the retardation of the diffusion by electrolytes is deduced. The divergence of the experimental data for gum arabic from these theoretical conclusions is discussed. The influence of the electrostatic forces between ions and particles on diffusion of colloids, considered qualitatively, furnishes an explanation of the dependency of the ion-effect on the valency and charge-sign of the added ions. [See also Abstract 2832 (1931).] T. H. P.

1420. Studies in Membrane Behaviour. Part I. Equilibrium Conditions with Gelatin Membranes in Acetate Buffer Solutions. W. L. Francis. *Roy. Soc., Proc.* 133. *pp.* 587–604, *Oct.* 1, 1931.—Measurements have been made of equilibrium membrane potentials for a buffer concentration gradient of 10 : 1 using 0·025–0·0025 *N* and 1–0·1 *N* solutions, the e.m.f. with and without gelatin on the membranes being compared over the pH range 2·35–7·3. The results, more particularly with the weaker solutions, appear to support the modified diffusion theory—that the anions are retarded in basic solution and the kations in acid solution—which interprets the potential in terms of altered ionic mobilities within the membrane, but the evidence is not direct. On the other hand, direct evidence, furnished by determinations of the transport numbers of the sodium and acetate ions across the membrane in 0·5 *N* solution, vetoes such theory. The value n_{Ac} does not change systematically with pH but remains steady throughout between the values 0·29 and 0·37. On the assumption that the membrane potential is made up of the ordinary diffusion potential and an opposed e.m.f. due to combination or adsorption of ions on the protein, an explanation of the variations of the membrane potential with pH and concentration is suggested which conforms with the known behaviour of gelatin in electrolytic solutions. T. H. P.

1421. Water Relationships in Colloids. Part I. Vapour Pressure Measurements on Elastic Gels. D. R. Briggs. *J. Phys. Chem.* 35. *pp.* 2914–2929, *Oct.*, 1931.—The isotenoscope method for measuring the vapour pressures of liquids is found to be especially rapid and suitable for the determination of the relative vapour pressure or activity coefficient of water contained in colloids. The measurements thus obtained are accurate to about 1 % when made at 25° C., and within the range of relative vapour pressures lying between 0·98 and 0·30 on the R.V.P. water-content curve. Above and below these values of relative vapour pressure, this method does not yield values which are as accurate as those which may be obtained from freezing-point data and from data obtained by allowing equilibrium to be attained over H_2SO_4–H_2O mixtures respectively. The limitations of activity data, as a means of differentiating between and of evaluating the individual forces which may be acting to reduce the activity of water in a given system, are discussed. Vapour pressure data of isoelectric casein and various sodium and calcium caseinates of varying kation content, are offered as evidence that the change in water-binding capacity (likewise swelling capacity) of a protein is the sum of the water-binding capacity of the isoelectric protein and that of the ionised atoms which are bound to the protein when the salts are formed. The sodium-caseinates are found to be nearly 100 % ionised as compared with the calcium caseinates, which are about 20 % ionised. Hence the antagonistic effects of these two kations in their influence upon the degree of hydration of colloids. H. H. Ho.

1422. Shape of the Particles in Hydrosols of Sodium Oleate. P. A. Thiessen and E. Triebel. *Zeits. f. phys. Chem.* 156. *Abt.A.* 4. *pp.* 309–316, *Oct.*, 1931.—Investigation of the flow double refraction of hydrosols of sodium oleate in relation to the velocity of flow, concentration and temperature shows that the colloidal particles in these hydrosols are rod-shaped. The existence of a true double refraction, superposed to the other, indicates that the particles are crystalline. T. H. P.

1423. Structure of the Lattice in the Sol-Gel Transition of a Colloidal System with Rod-Shaped Particles. P. A. Thiessen. *Zeits. f. phys. Chem.* 156. *Abt.A.* 5–6. *pp.* 457–468, *Oct.*, 1931.—The courses followed by the double refraction and electrical conductivity of a supercooled hydrosol of sodium oleate undergoing transition to the gel state under constant concentration and temperature conditions, together with data obtained concerning the nature of the fundamental particles, show that the formation of the lattice depends entirely on the size, shape and space-filling of the particles, and on the molecular orientation of, and charge-distribution on, the particles. T. H. P.

1424. Study of Colloidal Solutions by the Polarisation of Scattered Light. A. Boutaric and C. Tourneur. *Comptes Rendus*, 193. *pp.* 1011–1012, *Nov.* 23, 1931.—The processes leading to precipitation of colloidal solutions can be studied by observations of the polarisation of the scattered light. When a colloidal solution is diluted, the proportion P of polarised light in the scattered beam increases as the scattered intensity I decreases, and the relation $P = a - b \log I$ is found to hold over a wide range of concentrations. When an electrolyte is added to a colloidal solution, the initial value of P is that of the colloidal solution diluted with an equal volume of water. It falls to a limit P_l in a time depending inversely on the concentration of the electrolyte, and then increases as precipitation occurs. The time taken to reach the limit P_l is an exact measure of the time of flocculation, and agrees exactly with that deduced from observations of the intensity of the transmitted light. The time decreases with the quantity of electrolyte added, but for a given concentration P_l is independent of it. P_l decreases as the concentration increases for some solutions, passing through a minimum at a concentration c_m before reaching a constant value, while for others it remains constant at this minimum value. In all cases the concentration c_m separates the zone of rapid flocculation from that of slow flocculation. C. B. A.

1425. Preparation of Pure Magnesium by Sublimation. J. Hérenguel and G. Chaudron. *Comptes Rendus*, 193. *pp.* 771–773, *Nov.* 3, 1931.—The apparatus used, which is figured, is made of steel, calorised on its inner surface, with water-cooled joints made staunch with rubber. It can be evacuated and filled with argon. In a vacuum of 0·01 mm. mercury magnesium sublimes without melting at 600° at the rate of 1 kg. per hour. The silicon remains as $SiMg_2$; chlorine, sodium and carbon appear in the upper part of the condenser as $MgCl_2$, metallic sodium, and its carbide. The magnesium as sublimed contains 0·001 % Cl, $<$ 0·001 % Si and $<$ 0·01 % Fe; a resublimation leaves only $<$ 0·001 % Cl. The metal forms large dendrites which must be melted in argon. C. A. S.

1426. Effect of Cold-Working on the Physical Properties (Especially Electrical Resistance) of Aluminium. G. Greenwood. *Zeits. f. Krist.* 80. 5–6. *pp.* 481–494, *Nov.*, 1931. *In English.*—The specific electrical resistance of aluminium is increased by cold-working. This increase may be removed completely by annealing at 250° C. for 10 min. Annealing above this temperature causes another increase due probably to the production of cracks caused by the recrystallisation. Analogous results are obtained for the breaking stress. X-ray photographs show that the fibrous texture of cold-drawn aluminium wire is so persistent that recrystallisation is not complete even in wires annealed at 350° C. Further cold-working of the recrystallised wires breaks up the large grains and also produces a new fibrous texture in which the particles are arranged with the (100) direction parallel to the fibre axis. The production of the new texture is the more marked the higher the temperature of annealing.

F. J. W.

1427. Aluminium-Manganese System of Alloys. A. J. Bradley and Phyllis Jones. *Phil. Mag.* 12. *pp.* 1137–1152, *Dec.*, 1931.—An X-ray survey of the Al-Mn alloys indicates the existence of seven different phases. The addition of Al to Mn lowers the $\alpha\beta$ transformation point to such an extent that the β modification is stable at room-temperature. A preliminary equilibrium diagram is outlined. F. J. W.

1428. Zinc and its Alloys. *Bureau of Standards, Circ. No.* 395. [214 *pp.*], 1931.—The physical and mechanical properties of zinc summarised from the technical literature, together with results obtained at the bureau, are given. Special consideration has been paid to the effect of structural condition of the metal resulting from impurities and from such factors as mechanical working, recrystallisation, etc., upon the measured physical properties. The corrosion resistance of zinc, especially as related to its usefulness as a protective coating for steel, is discussed. The various alloy systems are summarised from the standpoint of constitution. Particular attention is given to the die-casting alloys and the properties which determine their usefulness industrially. A rather complete Bibliography is included in the form of selected references appended to the various sections in which the different properties are discussed.

1429. Crystal Structure and Atomic Properties of Alloys Containing Transition Elements. A. Westgren. *Frank. Inst., J.* 212. *pp.* 577–599, *Nov.*, 1931.—A summarising paper. F. J. W.

1430. Effect of Silicon on High-Chromium Steels. T. Murakami and K. Yokoyama. *Tohoku Univ., Technol. Reports,* 10. 2. *pp.* 57–78, 1931. *In English.*—The effects of silicon on the transformation points and structure of 20 chromium steels containing 9–16 % Cr, 0·3 % C and less than 3 % Si, are reported after investigation by magnetic, dilatometric and microscopic methods. The A_2 points of the alloys with a constant Cr content are lowered by Si additions, and those of the alloys with a constant Si content are lowered by Cr additions. In alloys with a constant Cr content, the amounts of the A_3 and A_1 transformations gradually decrease with increases of Si until they vanish, while the temperatures of these transformations rise. When Cr is added to alloys containing a constant amount of Si, the A_3 and A_1 transformations gradually decrease in amount until they disappear with the rise of transformation temperature. The carbon content in the eutectoid composition of high Cr steels decreases with additions of Si. C. O. B.

1431. Formation of Acicular Ferrite in Tungsten Steels. T. Murakami and S. Takeda. *Tohoku Univ., Technol. Reports,* 10. 2. *pp.* 79–106, 1931. *In English.*—By dilatometric measurements during cooling under various conditions, the critical points of tungsten steels were determined, and the effects of change of composition, maximum heating temperature and rate of cooling on the critical points were investigated. From microscopic examination it is confirmed that granular ferrite is formed on cooling at temperatures above 700°, while acicular ferrite separates at a lowered critical point below 500°. As the cooling rate increases, the acicular structure gradually resembles martensite. The changes of hardness and electrical resistance with cooling rate are also gradual. The mechanism of the formation of acicular ferrite is explained by Tammann's theory. C. O. B.

1432. Protection of Iron by Kathodic Polarisation. E. Herzog and G. Chaudron. *Comptes Rendus*, 193. *pp*. 587–589, *Oct*. 12, 1931.—The authors had previously shown that duralumin and iron could be protected from the action of aerated salt solutions by the additions of small quantities of certain salts [see Abstract 2854 (1931)]. The mechanism of this protective action is further investigated. Numerous experiments show that many deposits are capable of interfering with or preventing the formation of the Evans cell. Iron is protected in this way and retains its active potential. F. J. B.

1433. Rôle of Hydrogen in the Solution of Iron. H. Cassel, T. Erdey-Grúz and E. Liebreich. *Zeits. f. phys. Chem.* 156. *Abt.A*. 4. *pp*. 317–320, *Oct*., 1931.—An extension and criticism of the previously published paper of Liebreich [see Abstract 4342 (1931)]. F. J. B.

1434. Dissolution of Metals in Acids. J. N. Brönsted and N. L. R. Kane. *Am. Chem. Soc., J*. 53. *pp*. 3624–3644, *Oct*., 1931.—The view that dissolution of a pure metal in an acid solution is most probably the result of a chemical reaction between an electron in the metal and a molecule of the acid conforms with the extended theory of acids and bases. Na as amalgam dissolves in solutions of various acids with a velocity directly proportional to the square root of the Na concentration, the time required for the completion of the reaction being finite. The reaction of Na amalgam with aqueous NaOH is slow, but does not give reproducible results. The velocity of solution in aqueous phosphate, glycocoll and phenol buffers of constant H-ion concentration increases linearly with the buffer concentration. The molal reactivity constant of various acids tends to increase with the strength of the acid, but the effect of the charge of the acid, etc., may partly mask the strength effect. Owing to its high positive charge and the resulting strong attraction to the electron, the roseocobaltic ion, which bears three positive charges, reacts very readily with Na amalgam. In correspondence with the high strength of the hydrogen ion H_3O^+, this acid reacts with extreme speed; the dissolution of Na amalgam is therefore governed chiefly by the rate of the diffusion process. The rate of reaction of Na amalgam with a solution of phenol in dry benzene is proportional to the phenol concentration. T. H. P.

1435. Corrosion Tests for Unoxidisable Steels. J. Cournot. *Comptes Rendus*, 193. *pp*. 1091–1093, *Nov*. 30, 1931.—The comparative results of attack of steels containing 18 % Cr + 8 % Ni, 10 Cr + 23 Ni and 13 % Cr, and of pure iron by the methods of (*a*) alternate immersion and withdrawal; (*b*) application of spray, in both cases for 10, 20 and 50 days; and (*c*) attack by perhydrol for 1, 2 and 3 days, are shown by (loss of weight)/time curves. All methods are of value, the loss of weight shows the more uniform forms of corrosion, the results of stamping (not given) bring out irregular effects such as pitting. Results with (*c*) are less sensitive but more rapid. C. A. S.

1436. Rate of Solution of Different Faces of a Single Crystal of Copper. R. Glauner and R. Glocker. *Zeits. f. Krist.* 80. 5–6. *pp.* 377–390, *Nov.*, 1931.—The rates of solution of the different faces of a single crystal of copper have been measured in a series of inorganic and organic media. In many of the media the (111) face had the greatest and the (100) the smallest rate of solution. The influence of impurities in the copper on the rate of solution is discussed. F. J. W.

1437. Solutions of Metals in Non-Metallic Solvents. C. A. Kraus. *Frank. Inst., J.* 212. *pp.* 537–562, *Nov.*, 1931.—Existing knowledge of metals is far less extensive than that of non-metallic substances, as a result, largely, of the high boiling point, insolubility in non-metallic substances, high reflecting power, which renders accurate visual observations difficult, and absence of change on passage of an electric current. Some information has, however, been obtained by studying the behaviour of solutions of metals in non-metallic solvents. Thus it has been shown that solutions of the alkali and alkaline earth metals in anhydrous liquid ammonia contain positive normal ions of the metal and negative ions which are merely electrons, whilst intermetallic compounds such as Na_4Pb behave as true salts and yield positive and negative ions of the two metals, which may be separated by electrolysis. Although the metallic condition is in general restricted to matter in a highly condensed state, concentrated solutions in an ionising medium possess many of the characteristics of true metals. The physical and chemical properties of such solutions are reviewed in some detail. H. F. G.

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1438. Rectifier Effect and Heterogeneous Catalysis in Copper-Cuprous Oxide Systems. Wo. Ostwald and H. Erbring. *Kolloid Zeits.* 57. *pp.* 7–14, *Oct.*, 1931.—The earlier qualitative experiments [see Abstract 3831 (1930)] between the catalytic and rectifier effects of the Cu_2O-Cu system (on the oxidation of *p*-phenylenediamine) are now quantitatively substantiated. Good rectifier plates give in general larger amounts of aniline black and quinhydrone than bad plates. The rectifier and catalytic effects of the Cu_2O-Cu plate disappear by oxidation and reduction. The so-called stop-layer-free plates give positive catalytic effects and possess a positive rectifier effect when in conjunction with a pressed steel electrode. The recent experiments of Schottky, Störmer and Waibel are discussed with respect to the rôle of the external oxide layer, which appears to be the origin of the rectifier and catalytic effects. H. H. Ho.

1439. Retardation by Alcohols of the Hardening of Gypsum Cements. S. Yamane. *Inst. Phys. and Chem. Research. Tokyo, Sci. Papers, Nos.* 328–329. *pp.* 276–283, *Oct.*, 1931. *In Esperanto.*—The influence of methyl, ethyl and normal-propyl alcohols on the hardening of calcium sulphate cement has been studied by means of the ultramicroscope. The retardation observed is ascribed to the diminution of the difference between the supersaturated and normal solubilities. The differences observed are in the same order as the retardations produced by the different alcohols. The hypotheses of various authors relating to the influence of admixtures are critically reviewed. H. F. G.

1440. Dependence of Reaction Velocity on Surface and Agitation. Part III. Experimental Procedure in Study of Agitation. A. W. Hixson and J. H. Crowell. *Indust. and Engin. Chem.* 23. *pp.* 1160–1169, *Oct.*, 1931.—The values of the calculated constants obtained from the operation of the cube root law [see Abstract 647 (1932)] are found to be excellent criteria of the intensity of the agitation accompanying a reaction, and may therefore be used in the study of agitation in general. The idea of standard agitations of any type is developed, and a standard agitation for the free rotational type is established; certain régimes of flow occurring in agitation of this type are considered. For the dissolution system salt: water several variables affecting agitation of the free rotational type are studied, various proofs of the practical uses being indicated. The method of comparing the surfaces of particles of irregular shape by means of their rates of dissolution is shown, both theoretically and experimentally, to be reducible to a simple comparison of the velocity constants as obtained by application of the cube root law. Some of the properties of solid-liquid dissolution systems of extremely low intensities of agitation are described, and attention is directed to the occurrence of layers, high-concentration gradients, and other phenomena. The large-scale study of agitation is shown to be possible, and the cube root law is verified in this case also. T. H. P.

1441. Determination of the Stability of Smokeless Powders. F. Grottanelli. *Accad. d'Italia, Mem.* 26. (*Chim*), [17 *pp.*], 1931.—In the test proposed, use is made of 500 gm. of the explosive, which represents about one-half of the charge for a piece of land artillery of medium calibre. In this way, the autocatalytic effects of mass action are allowed play. The powder is employed in its original form and, in view of the fact that moist air has an important influence in the decomposition phenomena, the test is carried out in air which has been purified and then passed through water-scrubbers. Powders of high nitroglycerin content and not protected by special stabilisers are heated to 75° or 70° C., whilst those with less nitroglycerin and containing vaseline, diethyldiphenylurea, etc., may be heated to 80°–85° C. The moist air is passed over the heated powder in a glass tube in a thermostat, at the rate of about 0·05 litre per hour, and then bubbles through two absorption bulbs, each containing 50 c.c. of water free from CO_2 and saturated with quinhydrone. The development of acidity in the contents of the absorption bulbs is followed by measuring the pH. The silvered vessel test, the Abel test at 80° and the new test gave, respectively, 110–114 hours, 26–20 mins., and pH = 1 after 116 hours with a normal ballistite containing 50 % of nitroglycerin and made in 1930. T. H. P.

1442. Flame Temperatures of Mixtures of Methane-Oxygen, Methane-Hydrogen and Methane-Acetylene with Air. G. W. Jones, B. Lewis and H. Seaman. *Am. Chem. Soc., J.* 53. *pp.* 3992–4001, *Nov.*, 1931.—The temperature of the flame has been measured by the sodium-line reversal method, during the combustion of methane-oxygen, methane-hydrogen and methane-acetylene mixtures in air. In all cases, it is found that the highest temperature is reached when the mixture is slightly richer than the theoretical proportions for complete combustion. It is shown that the maximum flame temperature due to a mixture can be calculated from the known flame temperatures of the components. J. H. A.

1443. Chemical Action in Glow Discharge. Part VIII. Effect of Kathode Material. P. D. Kueck and A. K. Brewer. *J. Phys. Chem.* 35. *pp.* 3207–3213, *Nov.*, 1931.—Using the method previously described the effect of varying the material of the kathode was examined. Al, Sb, Cd, Ca, Fe, Pb, Mg, Ni, Sn, and W were used. The rates of synthesis of water and ammonia, especially of water, are approximately proportional to the normal kathode fall of potential of the metal concerned, but are clearly affected in some cases by the action of the reactants on the metal; with methane and oxygen the rate is the same for all materials as the kathode always becomes coated with a resinous deposit. This proportionality is attributed to increase in positive ion production with increased electron acceleration. Variation of the material of the anode has no effect. [See also Abstract 641 (1932).] C. A. S.

1444. Energy Diagrams of the Hydrogen Halides in the Gaseous State and in Aqueous Solution. P. J. van Rysselberge. *J. Phys. Chem.* 35. *pp.* 3371–3378, *Nov.*, 1931.—Homopolar, ionic, and polar compounds are discussed. (Interaction energy)/(distance between nuclei) curves are similarly [see Abstract 2877 (1931)] deduced for HF, HCl, HBr, and HI. All four in the gaseous state are homopolar. Their heats of dissociation when gaseous, deduced from energy data and heats of solution, differ from the heats determined thermochemically by amounts representing the energy of mutual polarisation of the atoms—amounting to about 1 volt-electron. C. A. S.

1445. Photochemical Kinetics of Chlorine-Hydrogen Mixtures. E. Hertel. *Zeits. f. phys. Chem.* 14. *Abt.B.* 6. *pp.* 443–456, *Nov.*, 1931. —When light of wave-length corresponding with that of the absorption bands is absorbed by chlorine, excitation, but no dissociation, takes place; nevertheless, when the irradiated gas combines with hydrogen the quantum yield is at least 10% of the yield obtained by irradiation with light of which the wave-length corresponds with that of the continuous absorption region. The process consists of a chain reaction, but the primary process differs from that in the short wave-length region; the excited chlorine molecules bring about the production of chlorine and hydrogen atoms by impact with chlorine, hydrogen and hydrogen chloride molecules, the activities of the three kinds of molecule being in the ratio 3: 1: 0·5. H. F. G.

1446. Photolysis of Potassium Ferrioxalate Solutions. Part III. A. J. Allmand and K. W. Young. *Chem. Soc., J. pp.* 3079–3087, *Nov.*, 1931.—Earlier work in this field is continued [see Abstract 396 (1930)]. The temperature coefficients of the quantum efficiencies in the photolysis of aqueous solutions of potassium ferrioxalate were determined. The wave-lengths of the light employed were 313, 365, 405, and 436. It was found that the effect of two monochromatic rays acting simultaneously was greater than the sum of the effects when acting separately. F. J. B.

1447. Photolysis of Alkyl Iodides. G. Emschwiller. *Comptes Rendus*, 193. *pp.* 1003–1005, *Nov.* 23, 1931.—A discussion of experimental work already published [see Abstract 2856 (1931)]. The results obtained may be explained on the hypothesis that the radiation produces both activation and dissociation of the iodide molecules. H. F. G.

1448. Problem of the Chemical Bond. F. Hund. *Zeits. f. Physik*, 73. 1–2. *pp.* 1–30, *Nov.* 24, 1931, and *ibid.*, 74. 5–6. *pp.* 429–430, *Feb.* 16, 1932.—Three conceptions of the chemical bond are critically discussed and compared [see also Abstract 3046 (1927)], preference being given to the Herzberg description of the state of the molecule by means of eigenfunctions of the separate electrons. The Herzberg assumptions are now extended and found to include valency conceptions—especially the idea of directed valency in a similar manner to the Slater-Pauling viewpoint, but much easier to comprehend—as well as the Hückel interpretation of a non-rotatory bond. H. H. Ho.

1449. Acid Standard Cells. Y. Ishibashi and T. Ishizaki. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 318. [12 *pp.*], *Sept.*, 1931. *In English.*—A continuation of investigations on the characteristics of acid standard cells with a description of the results obtained. The authors recommend the acidity of the electrolyte of about 0·05 *N*. The e.m.f.s of these cells at 20° C. are lower than those of Weston normal cells by nearly 42 microvolts. [See also Abstract 527 (1921).]

1450. International Weston Element and the Constancy of its E.M.F. H. v. Steinwehr. *Zeits. f. Intrumentenk.* 51. *pp.* 522–535, *Oct.*, 1931.—International efforts have been concentrated for some years on the establishment of accurate electric units, and one of these is of special importance whose value is deduced from the basic values of the ohm and ampere, that of the volt which is fixed through a complicated system, the so-called international Weston element. The working-out and establishment of this unit are discussed historically and in detail as to recent measurements at the Reichsanstalt, Charlottenburg, and elsewhere. The conclusion is that these measurements are in agreement with the summary given by Shaw and Reilley [see Abstract 1392 (1931)], who concluded that so far as their investigations had proceeded neutral standard cells had been found to be superior to acid cells as independent standards for a period of many years, though the latter were preferable for purposes of ordinary precision or shorter periods. J. J. S.

1451. E.M.F. Developed between Silicon and Other Elements in Solutions of Hydrofluoric and Sulphuric Acids and Sodium Hydroxide. C. Bedel. *Comptes Rendus,* 193. *pp.* 527–528, *Oct.* 3, 1931. —The e.m.f. of cells consisting of silicon (containing 0·1 % Fe) and nine other elements in 13·7 % HF, *N*–H_2SO_4, and *N*–NaOH has been measured. The three samples of silicon used show wide variations, the order of magnitude even varying in the different solutions. But Pt, Ag, and C (graphite) are always electropositive, Pb, Sn, and Zn electronegative; Cu, Ni, and Fe are negative in H_2SO_4, positive in NaOH; Cu and Ni positive, and Fe negative in HF. Variations of concentration of HF are of little effect. C. A. S.

1452. Abnormal E.M.F. of Filtration. L. Riéty and G. Salager. *Comptes Rendus,* 193. *pp.* 854–855, *Nov.* 9, 1931.—When solutions of mercuric cyanide of concentrations varying from 1 to 200 gm./l. are forced through a tube—of pyrex, ordinary glass or quartz—drawn out at one end, by a difference of pressure of 745 mm. of mercury, the p.d. at entering and leaving decreases from several, to 0·5 volts as the concentration increases. For varying pressures *p* the ratio p.d./*p* is constant. Mercuric chloride gives a p.d. about 0·25 of that given by the cyanide. C. A. S.

1453. Temperature Measurements at Active Electrodes. Part VI. R. Bružs. *Zeits. f. phys. Chem.* 156. *Abt.A.* 4. *pp.* 279–290, *Oct.*, 1931.—A dynamic calorimeter is described having a temperature sensitiveness of $1 \cdot 8 \times 10^{-6}$ °C./mm. and a Peltier-thermal effect sensitiveness of approximately $4 \cdot 5 \times 10^{-7}$ watt/cm.^{2}: mm. The Peltier coefficients have been evaluated by means of observations of temporary stationary states. The entropy of Cu^{++} has been calculated in three solutions of copper sulphate. [For Part V see Abstract 276 (1932).] H. H. Ho.

1454. Glass Electrode Determinations of Sodium in NaCl-KCl Mixtures. F. Urban and A. Steiner. *J. Phys. Chem.* 35. *pp.* 3058–3062, *Oct.*, 1931.—The glass electrode can function as a Na, K, Zn, or Ag electrode and, by the study of its potentials in a KCl-NaCl mixture to which varying amounts of NaOH were added, a method for the determination of the amount of sodium present was worked out. The determinations were carried out at a temperature of 25° C., and the glass electrode employed was of the Haber type. An equation for the mixed electrode potential is developed. F. J. B.

1455. Polarisation Capacity of Mercury Electrodes. T. Erdey-Grúz and G. G. Kromrey. *Zeits. f. phys. Chem.* 157. *Abt.A.* 3–4. *pp.* 213–241, *Nov.*, 1931.—A thermionic valve amplifier is described for use in conjunction with an oscillograph for the zero-current determination of voltage-time curves. Measurements which have been made with mercury electrodes demonstrate, at moderate mercury concentrations, pure concentration polarisation and, at very low concentrations, pure double-layer polarisation. The absolute values of the polarisation capacity in various electrolyte solutions have been determined. The kathode values are larger than the anode values, but both are in general much smaller than that calculated for the double layer from the electrocapillary curve. Sodium iodide solution forms an exception, in that the two capacity curves are in close agreement. H. F. G.

1456. Quantitative Limiting Law of the Viscosity of Strong Binary Electrolytes. H. Falkenhagen. *Phys. Zeits.* 32. *pp.* 745–764, *Oct.* 1, 1931.—The calculations formerly developed [see Abstracts 3662 and 3663 (1931)] for the variation of the viscosity in dilute solutions in the special case of binary electrolytes with ions of equal mobilities are extended to any simple electrolytes. The results of the somewhat complicated calculations are first discussed for binary electrolytes and are found to be in good agreement with the experimental data. A general discussion is to appear later. T. H. P.

1457. Conductivity and Dielectric Constant of Electrolytic Solutions at High Frequencies. M. Wien. *Ann. d. Physik,* 11. 4. *pp.* 429–453, *Oct.* 13, 1931.—The significance of simultaneous measurements of conductivity and dielectric constant is discussed in connection with the Debye-Onsager-Falkenhagen theory of electrolytes. By means of the Barretter method the conductivities and dielectric constants of different solutions of magnesium sulphate and barium ferricyanide have been measured for wave-lengths of 10, 20 and 40 m. The data are in good agreement with the above theory, and various deviations are discussed. H. H. Ho.

1458. Conductivity of Electrolytes in Motion. T. Franzini. *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 714–719, 1930–1931.—Experiment does not bear out the general belief that there is an apparent change in the conductivity of an electrolyte when set in motion. A. D.

1459. Sodium Coulombmeter. O. J. Stewart. *Am. Chem. Soc., J.* 53. *pp.* 3366–3369, *Sept.*, 1931.—In this paper a sodium coulombmeter of comparatively high conductivity is described, the anodic type being found to yield more accurate results than the kathodic type, their accuracy being at least 1: 10,000. An explanation of the inaccuracy of earlier sodium coulombmeters is submitted. H. H. Ho.

1460. Heyrovsky's Electro-Analytical Polarographic Methods and their Application in Theoretical and Practical Chemistry. W. Kemula. *Zeits. f. Elektrochem.* 37. *pp.* 779–793, *Oct.*, 1931.—A complete account of these methods is given with a full Bibliography. T. H. P.

1461. Electrolysis of Chromium Oxalates. A. Mazzucchelli. *Accad. d'Italia, Mem.* 2. 1. (*Chim.*) [15 *pp.*], 1931.—Homogeneous, uniform and adherent deposits of chromium may be readily obtained by electrolysis of chromo-oxalates in either acid (with oxalic acid) or alkaline (with ammonia) solutions. The process is inferior to the electrolysis of chromic acid, owing to the lower yields obtained, the higher current densities necessary and the unavoidable changes in the solutions during the hydrolysis, but the fact that electrolysis of ammonium chromo-oxalate takes place in a neutral or faintly alkaline medium, even in presence of a corrosive acid substance like chromium trioxide, may render the process useful in special circumstances. T. H. P.

1462. Quantum Mechanics of Electrolysis. R. W. Gurney. *Roy. Soc., Proc.* 134. *pp.* 137–154, *Nov.* 3, 1931.—A purely theoretical paper, in which the process of neutralisation of electrolytic ions on arrival at the electrodes is considered in terms of quantum mechanics. The theory developed is in quantitative agreement with the experimental data obtained by Bowden in connection with the polarisation of platinum electrodes in dilute sulphuric acid solution. H. F. G.

1463. Independence of the Hydrogen Content and Toughness of Electrolytic Iron. Guichard, Clausmann, Billon and Lanthony. *Comptes Rendus*, 193. *pp.* 1084–1085, *Nov.* 30, 1931.—Guillet, Roux and Cournot found that heating industrial iron to 350° for 24 hours removed only a part of the hydrogen and when heated to 1000° to remove more hydrogen the toughness was decreased [see Abstract 1015 (1932)]. These results are opposed to the authors' results [see Abstract 3619 (1931)], and they maintain that more prolonged heating would have removed all the hydrogen from the industrial samples of iron at temperatures below those at which the toughness would be affected. They do not consider it necessary to suppose the hydrogen is combined chemically with the iron. R. S. R.

1464. Electrolytic Dissociation and Activity Functions of Acids in Salt Solutions. Parts I and II. E. Larsson and B. Adell. *Zeits. f. phys. Chem.* 156. *Abt. A.* 5–6. *pp.* 352–396, *Oct.*, 1931.—Part I. Measurements of the potential of the quinhydrone electrode in 0·01 *N* HCl in presence of sodium, potassium, strontium or barium chloride at 18° C. give, for the activity coefficient of H-ions in these solutions, values in agreement with those obtained by Bjerrum and Unmack from measurements with the ordinary H electrode. Similar measurements have been made on solutions in which the HCl is replaced by acetic acid and sodium acetate, the activity functions $-\log f_H$, $-\log \frac{f_B}{f_{BH}}$ and $-\log \frac{f_H f_B}{f_{HB}}$

(where H, B, and HB refer to the H-ion, the acetate ion, and the acetic acid molecule respectively) being determined. With increase of the chloride concentration to about $0 \cdot 5\,M$, the magnitude of the classical ionisation constant increases, further chloride producing a decrease. By combining the activity functions with the values for f_{HB} determined from partition measurements, $-\log f_{\mathrm{B}}$ and $-\log f_{\mathrm{H}} f_{\mathrm{B}}$ are calculated. From the activity functions and dissociation constants obtained, formulæ are deduced which show the variation of these magnitudes with the salt concentration. Part II. By somewhat similar means, the complete and incomplete dissociation constants, K_a and K_{ac}, the concentration dissociation constant K_c, and the two activity functions, $-\log \psi = -\log \frac{f_{\mathrm{B}}}{f_{\mathrm{HB}}}$ and $-\log \phi = -\log \frac{f_{\mathrm{H}} f_{\mathrm{B}}}{f_{\mathrm{HB}}}$, in NaCl and KCl solutions up to $3\,N$ concentration are studied for the normal aliphatic acids with less than eight C atoms and for isobutyric, trimethylacetic and isocaproic acids. Since f_{HB} for these acids in the salt solutions is not known, $-\log f_{\mathrm{H}} f_{\mathrm{B}}$ and $-\log f_{\mathrm{B}}$ cannot be determined as with acetic acid. For all the acids, $-\log \psi$ and $-\log \phi$ show approximately the same variation with the nature and concentration of the salt present. Only with high salt concentration is the influence of the constitution of the acid appreciable. If the carboxyl group is united to a carbon atom carrying two or three H atoms, the values of $-\log \psi$ and $-\log \phi$ in a given salt solution are independent of the number of carbon atoms in the chain. In all other cases, these activity functions show higher values. For all the acids $-\log \phi$ has a maximum value in about $0 \cdot 5\,M$ salt solution, and in NaCl solution $-\log \phi$ is somewhat greater than in KCl solution of similar concentration. T. H. P.

1465. Activity Coefficient of the Cupric Ion in Solutions of its Sulphate. (Miss) M. Quintin. *Comptes Rendus*, 193. *pp.* 846–848, *Nov.* 9, 1931.—Debye's formulæ for the activity coefficient γ of an ion of valency ν in terms of concentration m, when the mean diameter of the ion a is, or is not, negligible, *i.e.*, respectively $\log \gamma = -\mathrm{A}e^2\sqrt{\Sigma m\nu^2}/2\mathrm{D}k\mathrm{T}$, and $-\mathrm{A}e^2\sqrt{\Sigma m\nu^2}/2\mathrm{D}k\mathrm{T}(1 + \mathrm{A}a\sqrt{\Sigma m\nu^2})$, where $\mathrm{A} = 2e\sqrt{\pi \mathrm{N}}/10\sqrt{10\mathrm{D}k\mathrm{T}}$, N is Avogadro's number, k Boltzmann's constant, e the electron charge, D the dielectric constant and T the absolute temperature, have been tested for solutions of cupric sulphate of concentrations $0 \cdot 01$ to $0 \cdot 5625$, by determining the e.m.f. of the cell

$$\mathrm{Cu} \mid \mathrm{CuSO_4},\ m \mid \mathrm{NH_4NO_3},\ \text{sat.} \mid \mathrm{KCl},\ \text{sat.} \mid \mathrm{Hg_2Cl_2} \mid \mathrm{Hg}.$$

a is practically constant unless m is $< 0 \cdot 16$, and $= 3 \cdot 8$ Å., and Debye's theory holds when the factor dependent on a is taken into account.

C. A. S

1466. Diffusion and Cataphoresis of Methylene Blue in Gelatin. Suzanne Veil. *Comptes Rendus*, 193. *pp.* 768–771, *Nov.* 3, 1931.—The spectrophotometric method was employed. Diffusion extends gradually, with no discontinuities [see Abstract 1344 (1929)]. Cataphoresis, however, produces marked singularities. A thick accumulation is first formed at the anode; this moves steadily away therefrom, leaving a clear space; then comes a series of thinner bands, and finally a thick one at the kathode.

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